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ATIKOKAN GS PREOPERATIONAL AQUATIC SURVEY YEAR III, 1983-1984

Report No 85-81-K

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ABSTRACT

The third year of preoperational biological studies was conducted at Atikokan GS from May 1983 through January 1984. Generally, parameters measured were consistent with those of the previous years. Notable differences occurred in the distribution of macrophytes in some areas and in the movements of walleye. Some of the observed differences were attributed to altered water levels, channelization or other construction activities.

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EXECUTIVE SUMMARY

ATIKOKAN GS PREOPERATIONAL AQUATIC SURVEY YEAR III, 1983-1984

G.T. Haymes

The third year of preoperat[illegible]l biological studies was conducted from May 1983 through January 1984. The objective of the preoperational program as requested by Environmental Studies and Assessments Department is to establish a baseline description of the aquatic environment so as to document changes that may result from station operation or construction.

As in previous years the lakes in the cooling chain were thermally stratified during the summer and oxygen depletion was apparent at depth both in the summer and winter. The lakes have relatively low alkalinity with moderate levels of nutrients and ions. The pH was higher than that reported in the two previous years. Generally, levels of many of the parameters were higher in Snow, Icy and Abie Lakes than in Slush and Marmion Lakes. Seepage of sewage from the lagoon into Snow Lake appeared to be non-human in origin and resulted in some nutrient enrichment in the lake.

As in previous years of the study submergent macrophytes formed the most widespread and abundant plant community type. Since 1982 significant changes in the species composition or macrophyte distribution had occurred in Snow Lake, the east bay of Icy Lake and at the Anderson Dam. The changes occurring in Snow Lake were likely the result of the rise in water level and the discharge of sewage into a stream flowing into the lake and are particularly important since they involved an expansion of the area occupied by *Elodea canadensis*, a species which has been problematic in other lakes where power plants have discharged thermal effluents. The changes in the east bay of Icy Lake involved a large reduction in the total area occupied by macrophytes, although similar species were observed in 1982 and 1983. Conversely the changes at the Anderson Dam involved an

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expansion of the area occupied by macrophytes due to the colonization of substrate 3.7 - 5 m deep by an unidentified charophyte. *Potamogeton richardsonii* also increased markedly in abundance in this area. Reduced water levels in Icy Lake during 1982 and stabilized water levels in Marmion Lake may have contributed to the observed changes in the vegetation of these two areas.

Diatoms and flagellates dominated the phytoplankton in all lakes except Snow Lake where blue-greens and diatoms were important. High abundance of blue-greens in Moose Lake and Snow Lake in the previous years was associated with altered water levels, although seepage of sewage into Snow Lake probably influenced the composition of phytoplankton in that lake. Primary production estimates resulted in the classification of Slush Lake as oligotrophic, Marmion Lake as transitional and Icy, Abie and Snow Lakes as secondary eutrophic. This classification is consistent with phytoplankton biomass estimates which were highest in Snow, Icy and Abie Lakes. Similarly the density of zooplankton was also highest in Snow, Icy and Abie Lakes.

Chironomids were the primary taxon collected in insect emergence traps. Theft and vandalism of the traps, however, made identification of spatial and seasonal trends tenuous.

Cyprinids were the most abundant fish in larval tows. Larval coregonids, primarily cisco were collected in relatively large numbers probably due to cooler temperatures during the first sampling period.

The nearshore forage fish community, sampled by beach seine, was dominated by mimic and blacknose shiners and yellow perch. Catches in beach seines were generally higher in the upper chain of lakes (Snow, Icy and Abie) than in Marmion Lake.

Cisco was the most common species caught in gill nets. The catch in gill nets was greatest at Anderson Dam and lowest in Moose Lake. The low number of fish caught in Moose Lake probably reflects a dilution effect as the lake was refilled during 1983. The low density of fish in Moose Lake will probably have an impact on fish impingement trends during the first few years of station operation.

Ripe walleye were observed and probably spawned at the West Dam at Marmion North, Anderson Dam and at the Spillway Dam in Marmion Lake and in Icy Lake at the outflow of Ski Lake. Recapture of marked walleye suggests that walleye from the Upper Seine River may utilize the spillway dam to spawn and that removal of the small weir between Icy and Abie Lakes has resulted in the movement of fish from Abie and probably Marmion Lakes into Icy Lake to spawn.

Analysis of scales of cisco suggests substantial differences in age distribution and growth of cisco from Snow and Slush lakes and those from Icy and Abie Lakes. Those from Snow and Slush Lakes tended to be younger and slower growing than those from the latter lakes.

Gut content analysis of walleye, northern pike, lake whitefish and cisco indicated that walleye and pike fed primarily on yellow perch and cisco while lake whitefish were primarily bottom feeders. Some cisco appeared to be feeding primarily from the bottom while others appeared to be primarily planktivorous feeding on cladocerans and copepods.

Generally results from 1983 do not suggest substantial differences from previous years, however, a few differences were apparent which may have been the result of construction activities. These include effects of channelization on walleye movements, altered water levels on fish density and macrophyte distribution and seepage of sewage into Snow Lake on production and macrophyte distribution.

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To Dr. C.W. Dawson
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ATIKOKAN GS PREOPERATIONAL AQUATIC SURVEY YEAR III, 1983-1984

1.0 INTRODUCTION

Atikokan GS, currently under construction, will consist of one 200 MW lignite-fired unit. The condenser cooling water for Atikokan GS will be drawn from approximately the 10 m depth in Moose Lake and discharged on the surface into Snow Lake. The discharge water will circulate through Icy, Abie and Marmion Lakes before returning to Moose Lake (see Figure 1).

At new Ontario Hydro generating stations, three years of aquatic surveys are conducted prior to commissioning of the first unit. The purpose of these three years of study as requested by Environmental Studies and Assessments Department, Design and Development Division is to establish a baseline description of the physical-chemical and biotic features of the aquatic environment in sufficient detail to document significant changes in those features during similar studies conducted during the operation of the station. The results of the first two years of study are presented in Ontario Hydro Research Division Report Nos 83-338-K and 84-54-K.

Study Area

The study area consists of the five lakes of the cooling circuit; Snow, Icy, Abie, Marmion and Moose, along with two control lakes, Lower Seine Lake, on Marmion Lake and Slush Lake.

Ten locations were chosen for study in 1983; one each in Snow, Icy, Abie, Slush and Moose Lakes, and Lower Seine Lake and four in Marmion Lake (Figure 1). Marmion Lake locations included one in the basin north of Anderson Dam, one at the outlet of

FIGURE 1

COOLING WATER CIRCUIT - NOKAN CS

Abie lake, one at the West Dam (Marmion North), and the last in the central section of the lake. Seven of these locations (Snow, Icy, Slush and Abie Lakes, Marmion South, North and Anderson Dam) were selected for intensive study. Only fishing was conducted at the remaining three locations.

During most of the year III study water levels in Moose, Snow and Icy Lakes were at or near levels typical of the operational phase but with no pumps operating. Water levels in these lakes were below operational levels in both or one of the two previous years of study. Snow, Icy and Abie Lakes will be higher by approximately 40, 20 and 10 cm, respectively, during full pumping.

2.0 METHODS

The sampling locations utilized in 1983 are presented in Figures 2 to 7 and the sampling schedule is presented in Table 1.

2.1 Physical-Chemical Characteristics

2.1.1 Temperature, Dissolved Oxygen and Transparency

Water temperatures were continuously monitored by Hydraulic Studies and Development Department in Marmion, Icy and Moose Lakes during 1983. Temperature and dissolved oxygen profiles and Secchi depth were taken monthly (May to October and January) at the maximum depth location at each of the ten sampling basins using a Hydrolab 4000 temperature and dissolved oxygen recorder.

2.1.2 Water Chemistry

Surface and bottom water samples were collected in May, August, October and January from the maximum depth location of Snow, Icy, Abie and Slush Lakes and from Marmion South and North and Anderson Dam. Chemical parameters measured are listed in Table 2.

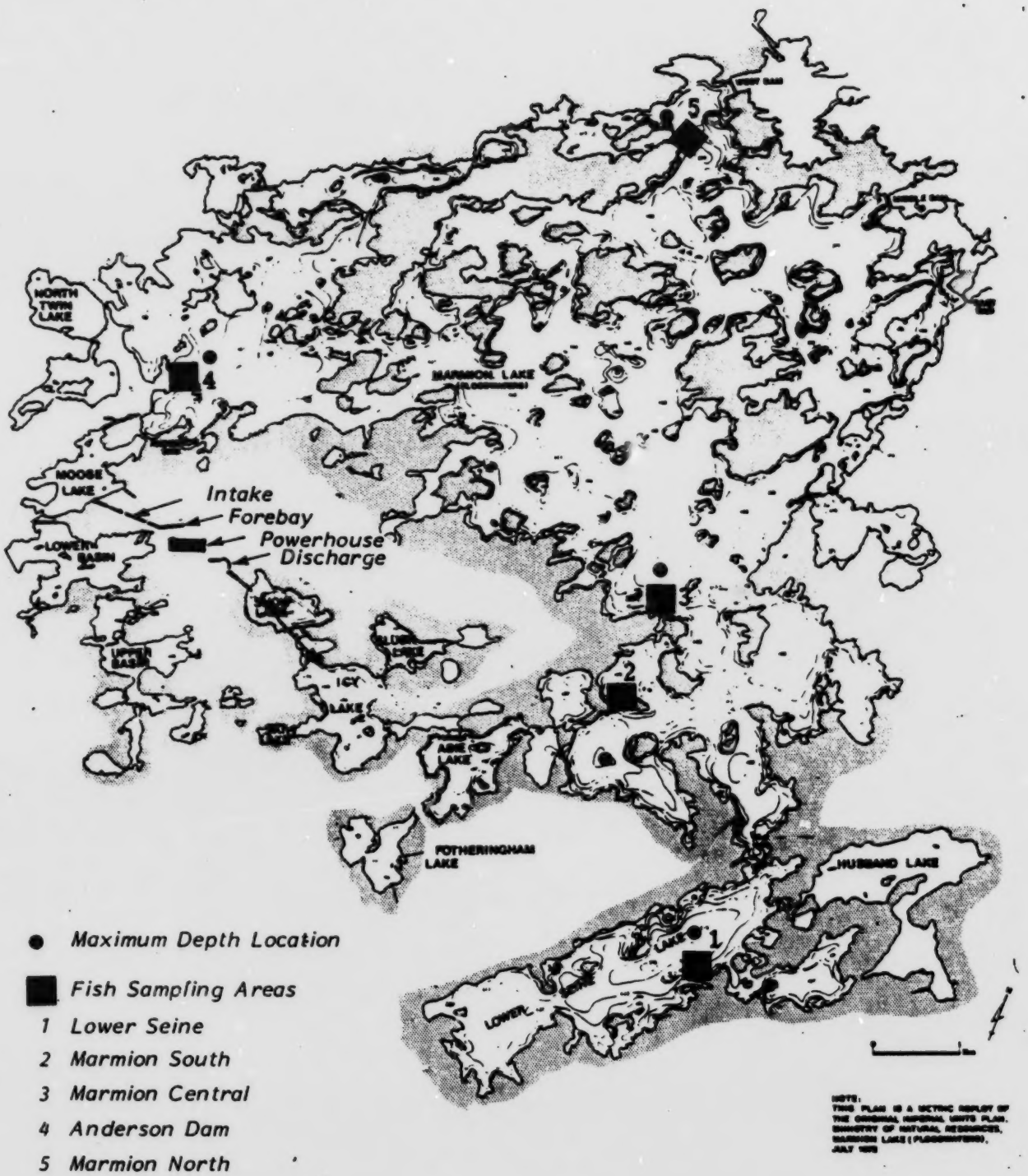

FIGURE 2

SAMPLING LOCATIONS MARMION LAKE - YEAR III

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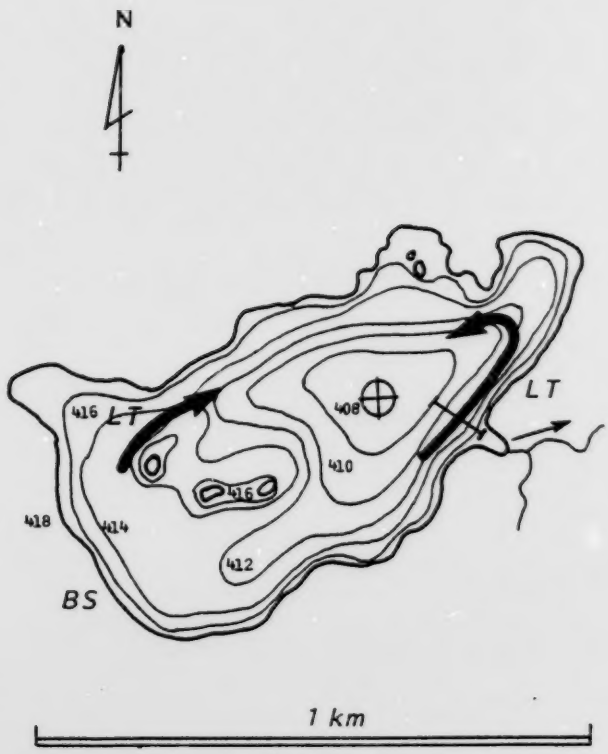


LT — Larval Tow

BS — Beach Seine

Maximum Depth Location

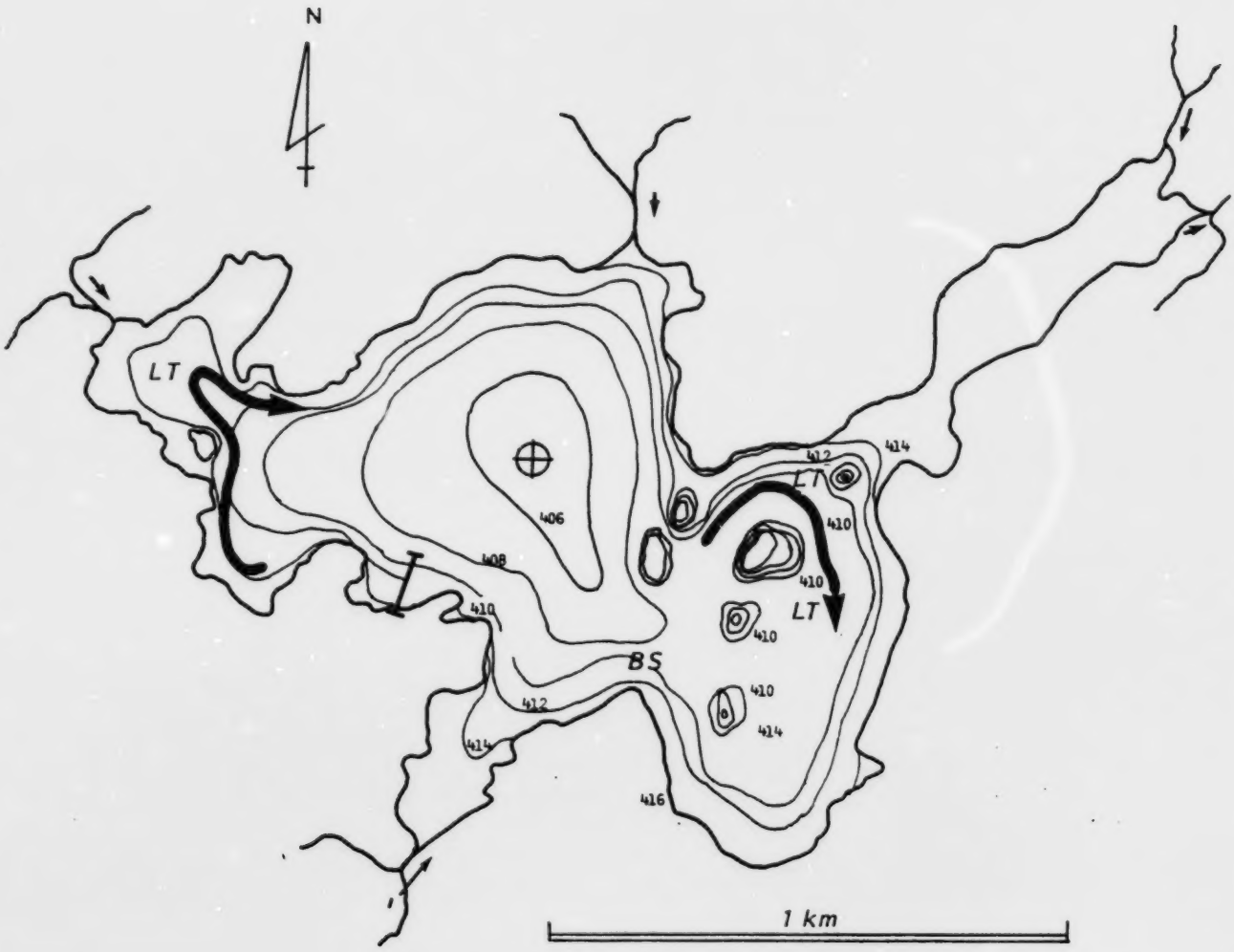
Direction of Flow

Gill Net

Elevations in meters above sea level

FIGURE 3

SAMPLING LOCATIONS SNOW LAKE - YEAR III



Gill Net

Direction of Flow

LT Larval Tow

Maximum Depth Location

BS Beach Sein

Elevation in metres above sea level

FIGURE 4

SAMPLING LOCATIONS ICY LAKE - YEAR III

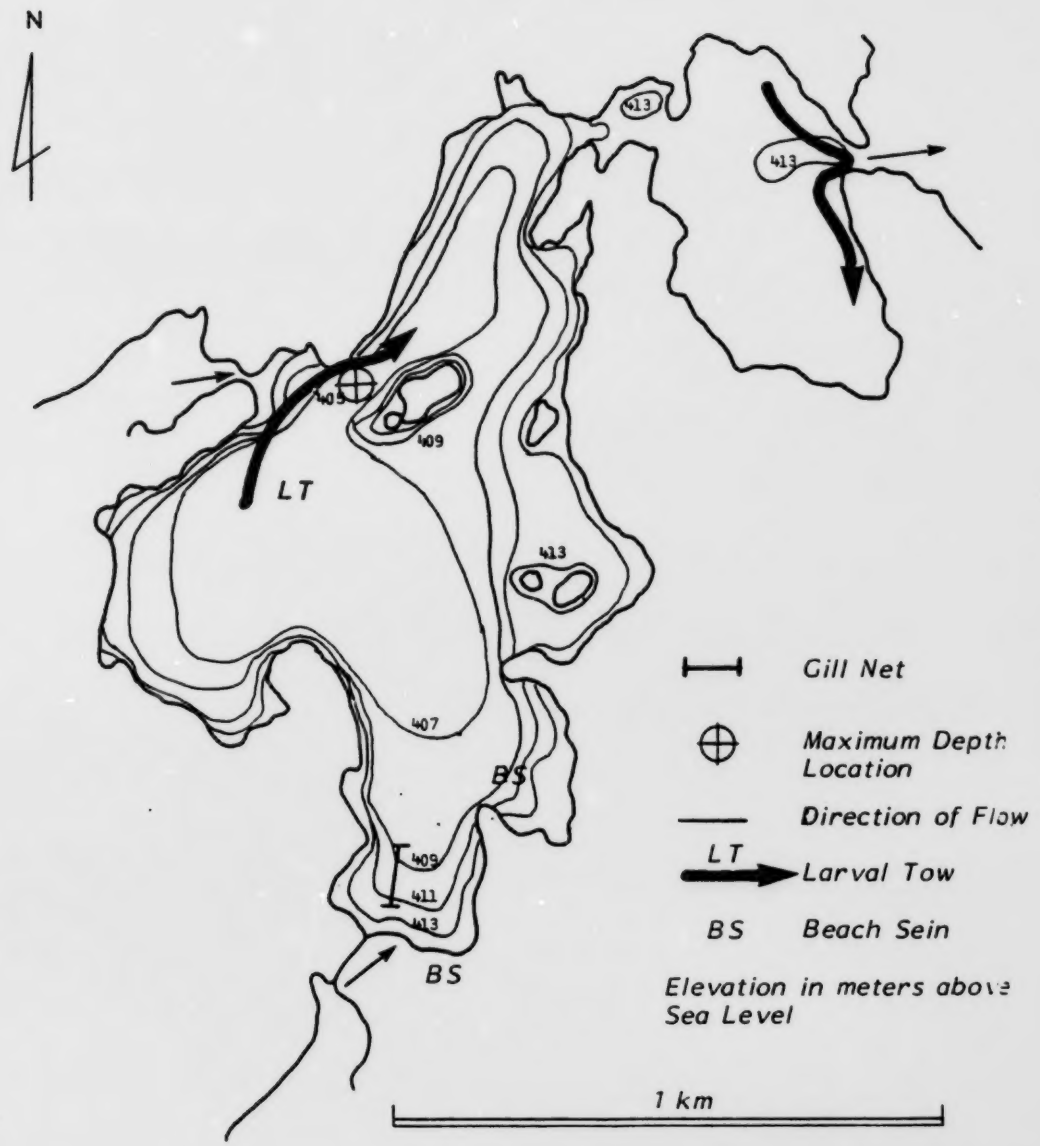
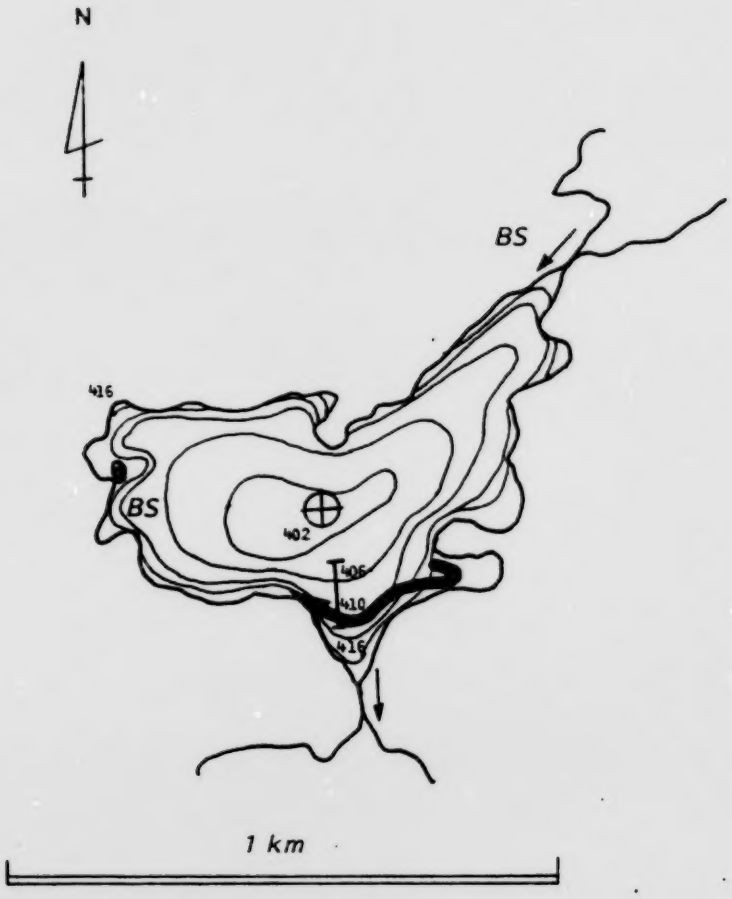


FIGURE 5

SAMPLING LOCATIONS ABIE LAKE - YEAR III



BS - Beach Seine

LT Larval Tow

Gill Net

Maximum Depth Location

Direction of Flow

Elevation in metres above sea level

FIGURE 6
SAMPLING LOCATIONS SLUSH LAKE - YEAR III

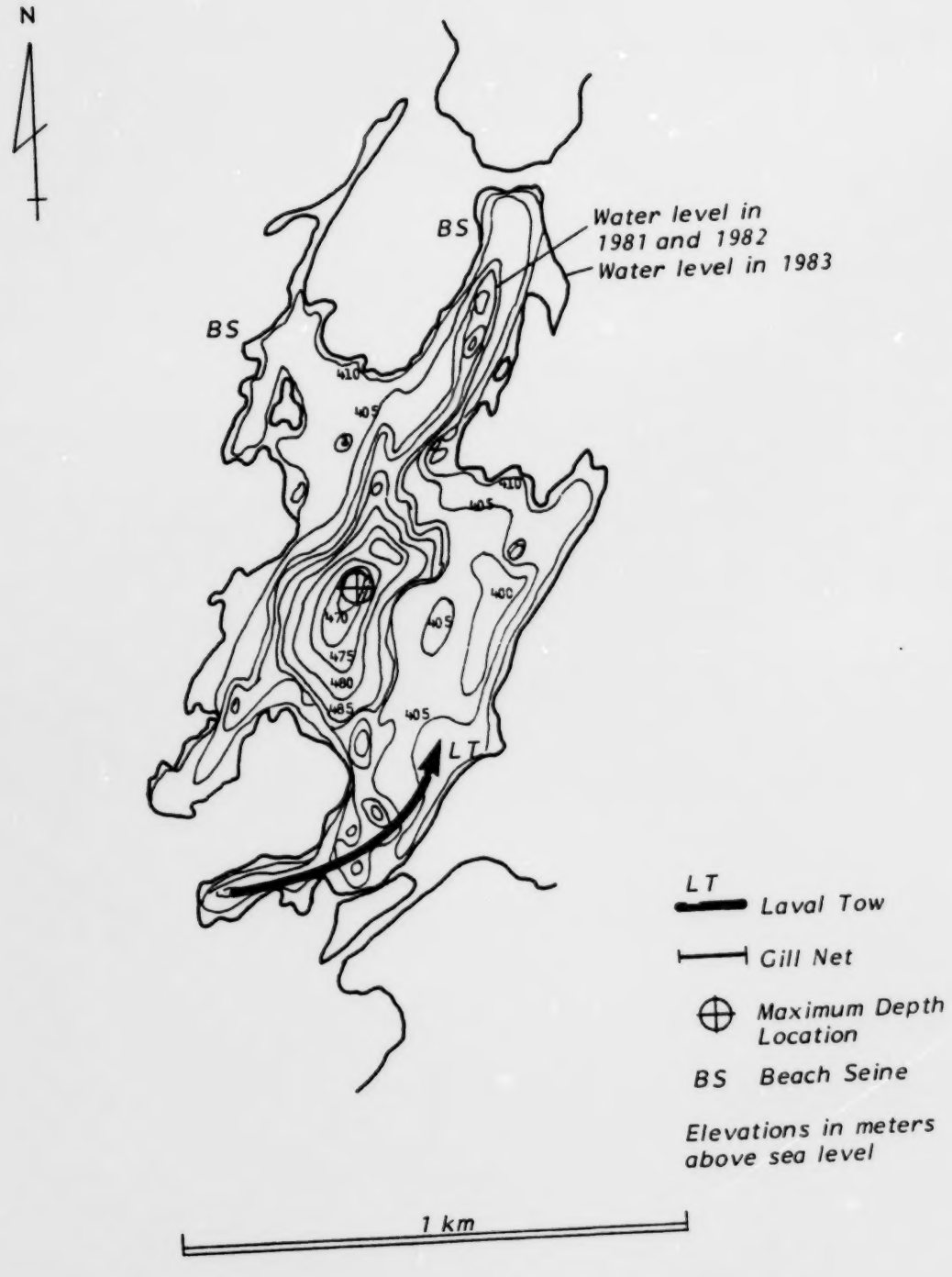


FIGURE 7

SAMPLING LOCATIONS MOOSE LAKE - YEAR III

TABLE 1

SAMPLING SCHEDULE ATIKOKAN 1983, 1984

	May	June	July	Aug	Sept	Oct	Nov	Jan
Temperature and Dissolved Oxygen	X	X	X	X	XX	X		X
Transparency	X	X	X	X	XX	X		
Water Chemistry	X			X		X		X
Macrophytes				X				
Phytoplankton	X	X	X	X	X	X		
Primary Production	X	X	X	X	X	X		
Zooplankton	X	X	X	X	X	X		X
Emergence Traps	———	———	———	———	———			
Larval Tows	XX	XX	X					
Beach Seines	X	X	X	X	X	XX		
Gill Nets	XX	XX	X	X	XX	XX	X	

TABLE 2

WATER CHEMSTRY PARAMETERS

Turbidity	Sodium
Specific Conductance	Potassium
pH	Filtrable Iron
Total Hardness	Total Iron
Alkalinity	Nickel
Filtrable Residues (105°C and 550°C)	Aluminum
Non-Filtrable Residues (105°C and 550°C)	Copper
Total Silica	Zinc
Soluble Silica	Manganese
Total Phosphorus	Mercury
Soluble Phosphorus	Arsenic
Total Kjeldahl Nitrogen	
Nitrate	Selenium
Total Organic Carbon	
Total Inorganic Carbon	
Sulphate	
Chloride	
Ammonia	
Calcium	
Magnesium	

2.2 Biological Characteristics

2.2.1 Macrophytes

The purpose of the 1983 study was to resurvey the macrophyte vegetation in the seven bays examined in 1982. Six of the bays are on the cooling circuit and the seventh, a control, is on Slush Lake (Figure 8). The resurvey was conducted during the second week of August and was expected to provide information on any changes in species composition, depth distribution or per cent bottom cover that had occurred as a result of natural causes or construction activity.

The sampling methods were the same as those used in 1982. Within each bay, the transects established in 1982 were cruised by observers in a boat or by a snorkeller who identified the species present and described the vegetational patterns. Voucher specimens of species which were difficult to identify in the field were collected and later identified using the keys in Fassett (1975), Gleason (1968), Voss (1972), Riley (1979), Hellquist and Crow (1980) and Crow and Hellquist (1981). Maps were prepared to show the distribution of emergent, floating leafed and submergent vegetation.

2.2.2 Phytoplankton

Phytoplankton samples were collected using a 3-m PVC tube monthly from May to October 1983 and in January 1984 from Snow, Icy, Abie and Slush Lakes, Marmion South, Marmion North and Anderson Dam.

In addition, primary production was determined by the carbon-14 method of Steemann-Nielson (1952) at each of seven locations sampled for water chemistry and plankton. Determinations were made monthly from May to October, 1983, and in January, 1984.

Samples were taken from the 0 to 3 m depth with a 3-m polyvinyl chloride tube (2.5 cm ID) equipped with a self-closing butterfly valve, and were dispensed into 4 L amber polyethylene bottles for transportation. Triplicate 125 mL glass-stoppered bottles were filled with sample water from each lake location within 5 h of collection. A composite sample prepared by mixing 100 mL of lake water from each location was heat sterilized at 90°C for 5 min and then was dispensed into three bottles to serve as the control. All equipment was rinsed thoroughly before sample collection or transfer.

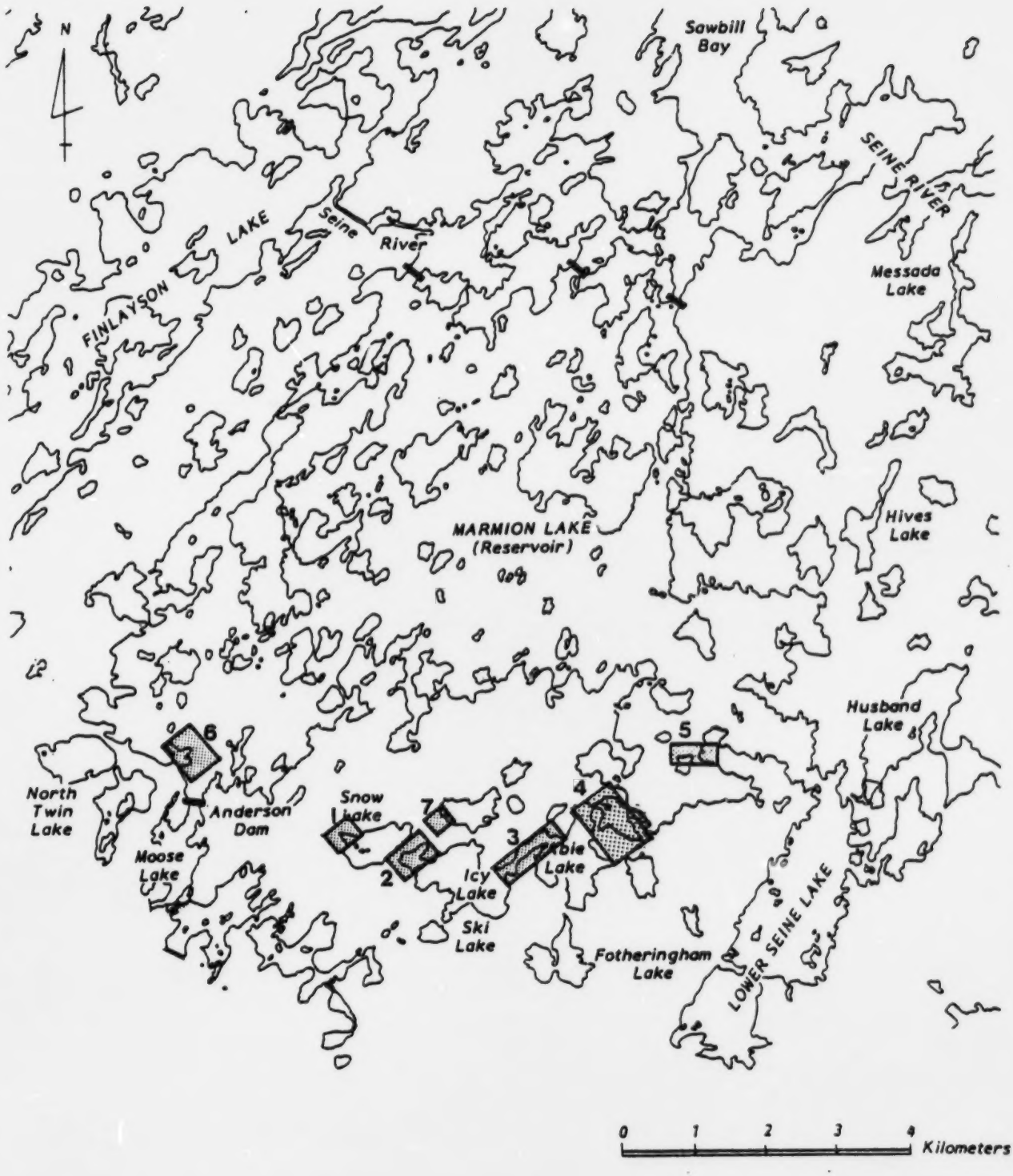


FIGURE 8

MACROPHYTE SAMPLING LOCATIONS IN 1983

Sample bottles were placed in a water bath incubator maintained at ambient lake water temperature (±2°C) and were illuminated with 4 300 ± 400 lux from a bank of ten 20 W fluorescent lamps (Ontario Hydro Research Division Report No C77-127-K). After a 0.5 h adaption period, 2 to 4 μCi of sodium (^{14}C) bicarbonate was added to each bottle. After thorough shaking, two 2 mL aliquots were removed from each bottle for determination of initial radioactivity, and bottles were returned to the incubator.

Following a 2 to 4 h incubation period, duplicate 20 mL aliquots from each bottle were filtered on HA 0.45 μMillipore filters (250mm dia. gridless). The carbon-14 retained by the cellular fraction, which was generally one to two orders of magnitude above background radioactivity levels, was measured. Filtrates were collected, acidified with HCl to pH 3.5, aerated vigorously for 20 min, and 1 mL aliquots were taken for the measurement of soluble ^{14}C organic compounds released by phytoplankton cells (Fogg 1971). Extracellular release was low, averaging 7.0 ± 5.7% (1 SD) of total carbon fixed, with no pattern in levels of release apparent among locations.

Radioactivity measurements were made with a Packard Tri-Carb 300 Scintillation Counter. Filters and aqueous samples placed in PCS II scintillation cocktail (Amersham) formed homogeneous solutions. Counts (dpm) retained by filters were corrected for radioactivity of heat sterilized control samples while zero time totals and filtrate counts were corrected for an average background activity of 31 dpm.

Radioactive counts of the two filters from each replicate bottle were averaged. Primary production (P) expressed as mg C fixed/m^3/h was determined for each bottle as follows:

$$P = \frac{\text{Cellular } ^{14}C \text{ filters in dpm/mL}}{\text{Total } ^{14}C \text{ added in dpm/mL}} \times \text{DIC(mg C/m}^3) \times \frac{60}{\text{Incubation time (min)}}$$

where DIC was the dissolved inorganic carbon content of the samples, determined by the method of Saunders *et al* (1962). Excreted carbon was determined by using filtrate dpm values in place of filter dpm values in the above equation. Total primary production was the sum of cellular and excreted carbon fractions except for May 17 when only cellular carbon was measured. Primary production estimates were not corrected for dark $^{14}Co_2$ fixation [because of uncertainty associated with this process] (Morris et al 1971; Peterson 1980).

2.2.3 Zooplankton

Zooplankton samples were collected at the same locations and at the same frequency as phytoplankton. A Schindler-Patalas trap was used to collect samples at two metre intervals through the water column. These samples were mixed to provide an integrated zooplankton sample.

The zooplankton samples collected in Icy Lake in May, June and July were separated by sieving through four mesh sizes (64, 160, 243 and 320 μm). The species composition of the size categories were then applied to the samples from other locations to give an estimate of the size distribution at those other locations.

2.2.4 Emergence Traps

Emergence traps with a 0.25 m^2 opening were set in Snow, Icy, Abie and Slush Lakes and in Marmion Lake at Marmion South, North and Anderson Dam. One trap was set at each of a 3 m vegetated, 3 m non-vegetated, 7 m and at the maximum depth locations. The contents of the emergence traps were collected at monthly intervals. The taxonomic composition was determined and the dry weight of the whole sample and of the major taxa in the sample were also measured. Due to apparent vandalism and theft, many of the emergence traps did not provide usable samples.

2.2.5 Fish

A survey of walleye spawning grounds was made on several evenings during early May. Walleye were collected by dip net or electro-shocker. Females were retained for fecundity analysis while males were tagged and released.

Larval fish were collected in May, June and July. Duplicate, five minute surface tows were made during daylight parallel to shore in each sampling basin at approximately 1 m/s. Two locations in Snow, Icy and Abie Lake were sampled. Tows were made using a set of two, 0.5 m conical nets with a mesh size of 363 μ.

Juvenile and forage fish were collected by beach seine in each basin twice in May, June, September and October and once in July and August. Hauls were made at one vegetated and two non-vegetated locations in each basin using a 15 m (approximate) beach seine.

Two hour (approximate) evening gill net sets were employed to sample juvenile and adult fish in each basin. Gill nets with 15 m panels with 3.8 to 12.7 cm mesh in 1.3 cm increments were set twice in May, June, September and October and once in

July, August and November. Walleye, northern pike, cisco and lake whitefish captured in gill nets were generally measured, weighed, and a scale sample was taken for age determination before release. Walleye and northern pike were tagged. Some of these species were collected for analysis of gut contents and gravid females, when encountered, were collected for fecundity analysis. For fecundity estimates a sample of 100 eggs was weighed and compared to the total weight of the contents of the ovary. Voluntary creel census forms were placed at the Anderson Dam. These were supplemented by occasional angler interviews and counts of anglers encountered during visits to estimate angler catches and effort.

3.0 RESULTS AND DISCUSSION

3.1 Physical-Chemical Characteristics

3.1.1 Water Temperatures

Continuous temperature monitoring by Hydraulic Studies and Development Department in Icy and Marmion Lakes during 1981 indicated that sub-surface (1.6 m) waters in Icy Lake warmed at a quicker rate in May and remained 1 to 2°C higher than those in Marmion Lake until late August (Figure 9). Temperatures at 10 m depth in Marmion Lake increased gradually during the summer until the thermocline reached the 10 m depth by mid September and temperatures were similar to those at 1.6 m.

Temperature profiles are listed in Appendix 1 and summarized in Figures 10 to 12. A thermocline formed in all basins during the summer. The depth of the thermocline was stable at 5 to 6 m in the protected smaller lakes and 6 to 9 m from July through early September in Marmion Lake (Table 3). By late September the thermocline dropped or disappeared.

The maximum surface temperatures recorded ranged from 23.4°C (Anderson Dam) to 25.6°C (Slush Lake). Maximum bottom temperatures ranged from 4.9°C (Slush Lake) to 13.8°C (Anderson Dam) while minimum bottom temperatures recorded ranged from 1.2°C (Icy Lake and Marmion Central) to 2.7°C (Marmion North). It should be noted that the depth to which temperatures were recorded was limited by the length of the probe, 16 m, which in the deeper basins is above the bottom.

3.1.2 Dissolved Oxygen

Dissolved oxygen profiles are listed in Appendix 1 and areas of low oxygen concentration are illustrated on Figures 10 to 12. As in the previous years oxygen in all of the basins was depleted near the bottom during the summer. The minimum depths

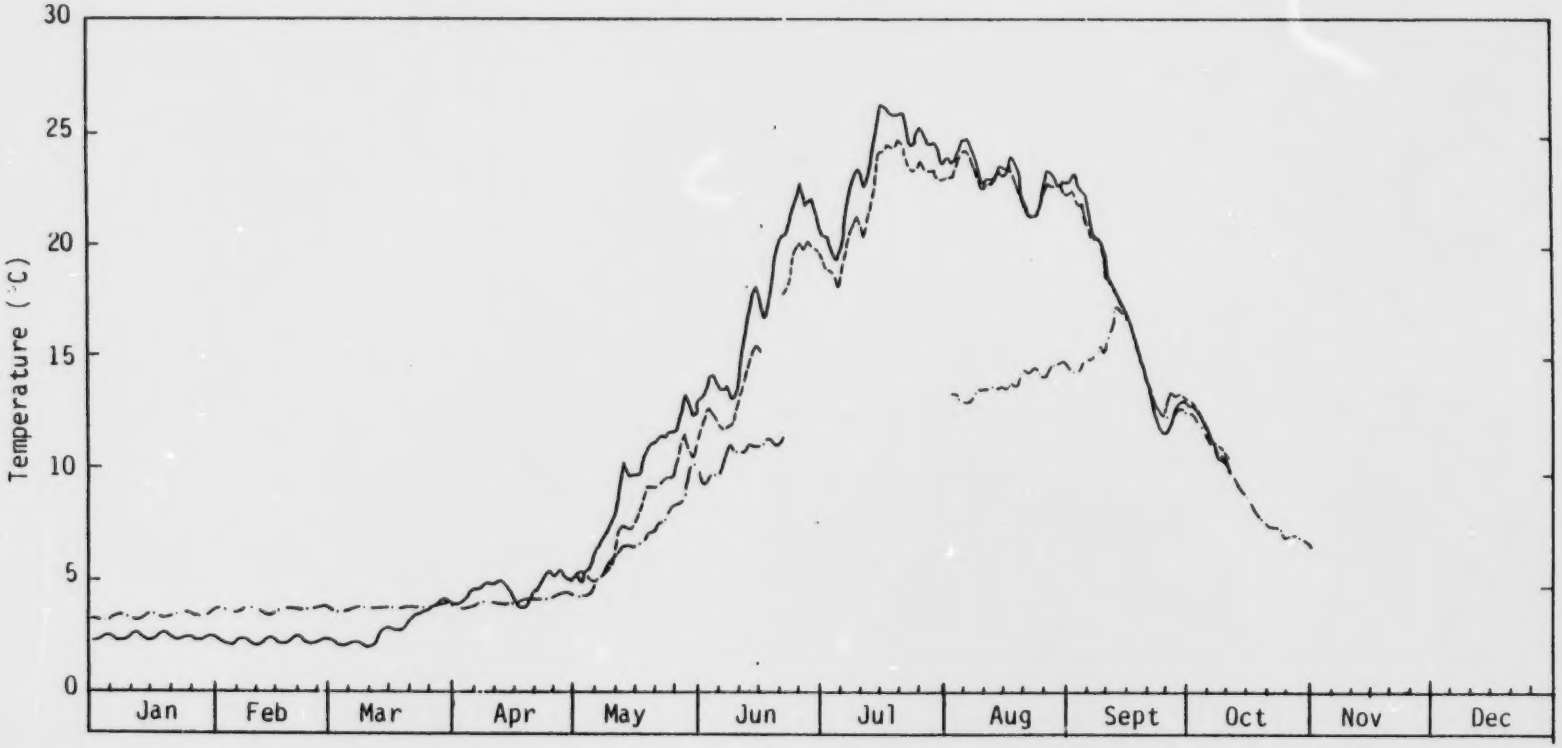


FIGURE 9

DAILY MEAN WATER TEMPERATURES IN MARMION AND ICY LAKES - 1983

85-81
168237-RD

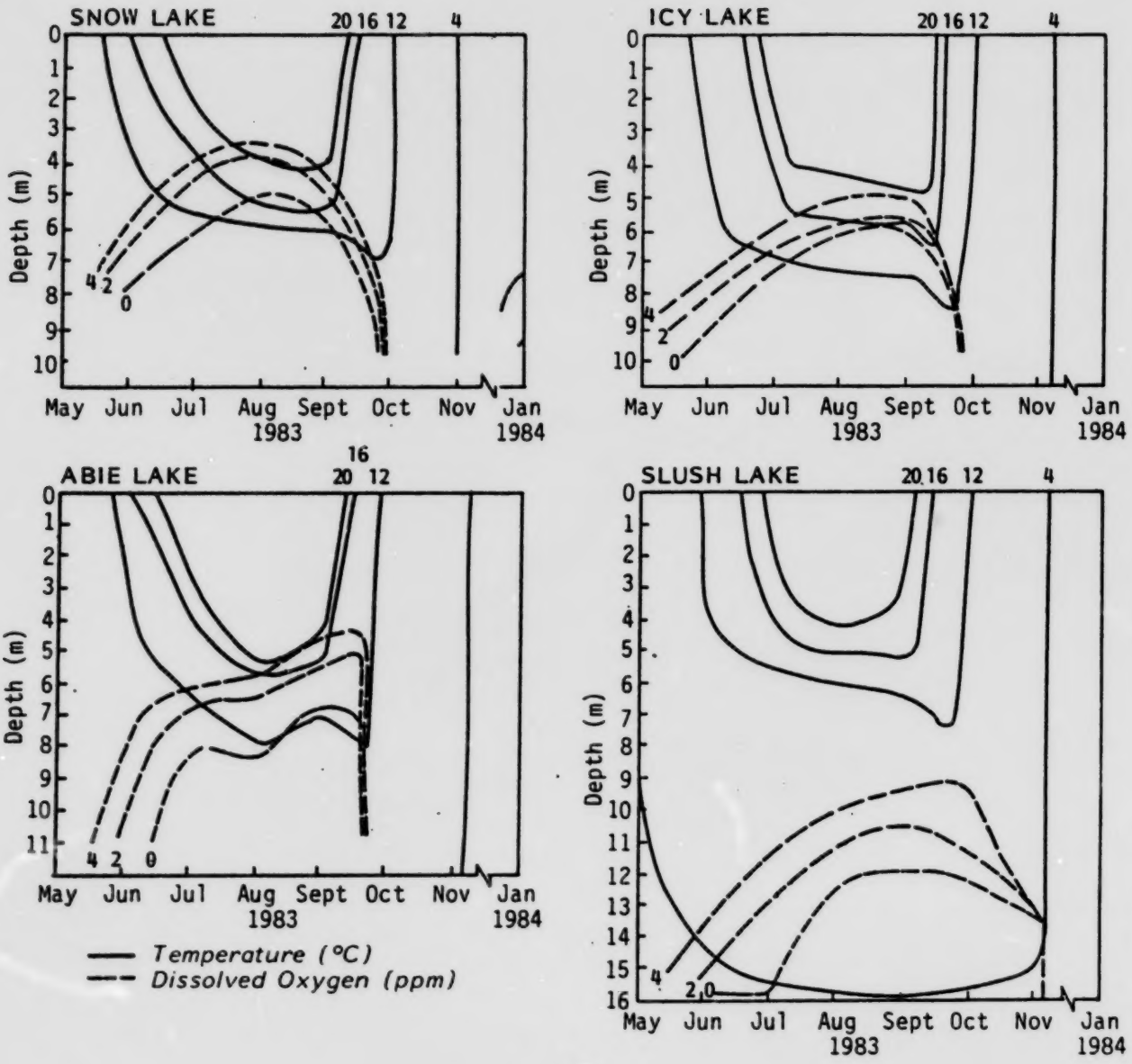


FIGURE 10

TEMPERATURE AND DISSOLVED OXYGEN LEVELS
IN SNOW, ICY, ABIE AND SLUSH LAKES, 1983

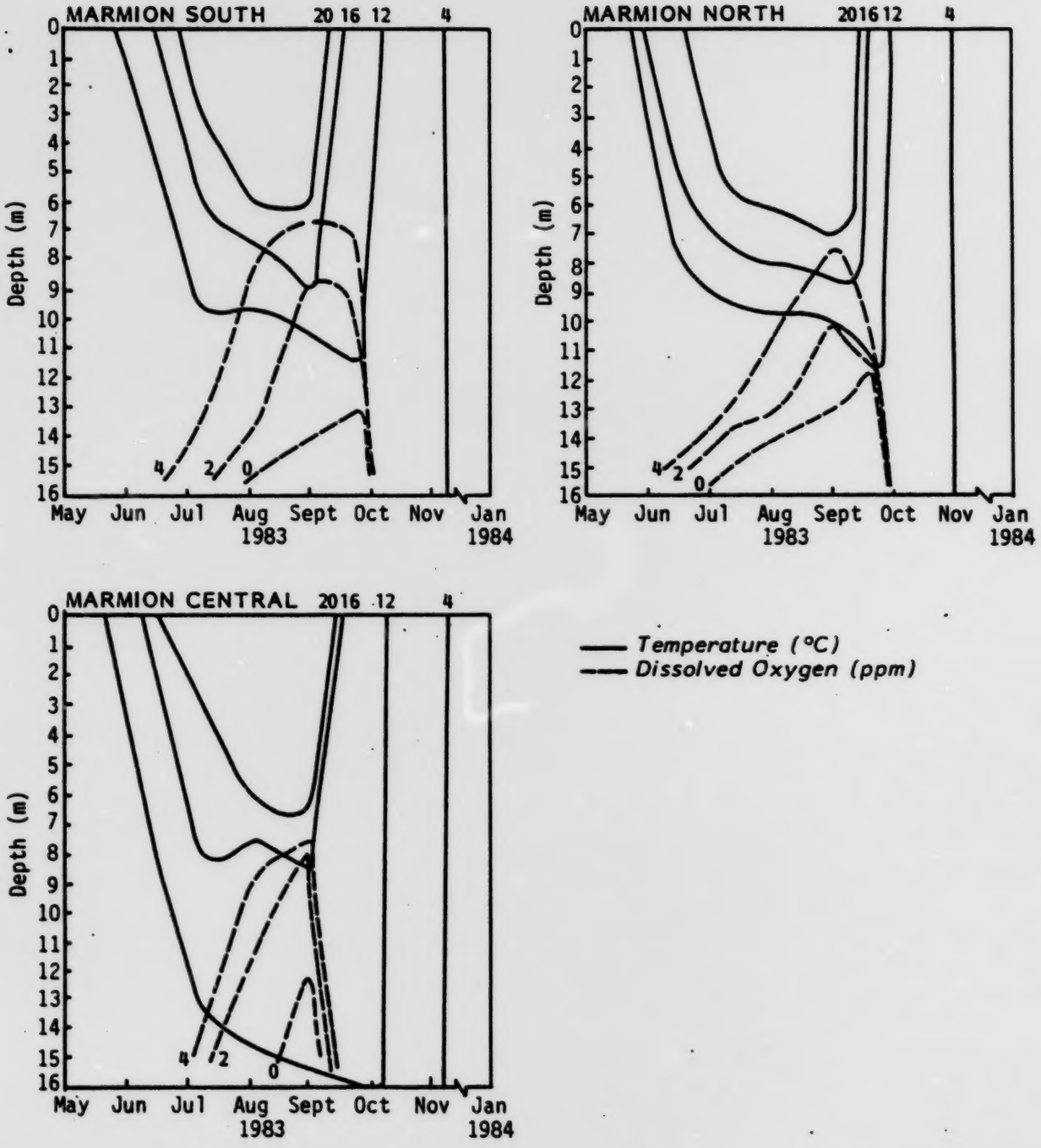


FIGURE 11

TEMPERATURE AND DISSOLVED OXYGEN LEVELS AT MARMION SOUTH, CENTRAL AND NORTH, 1983

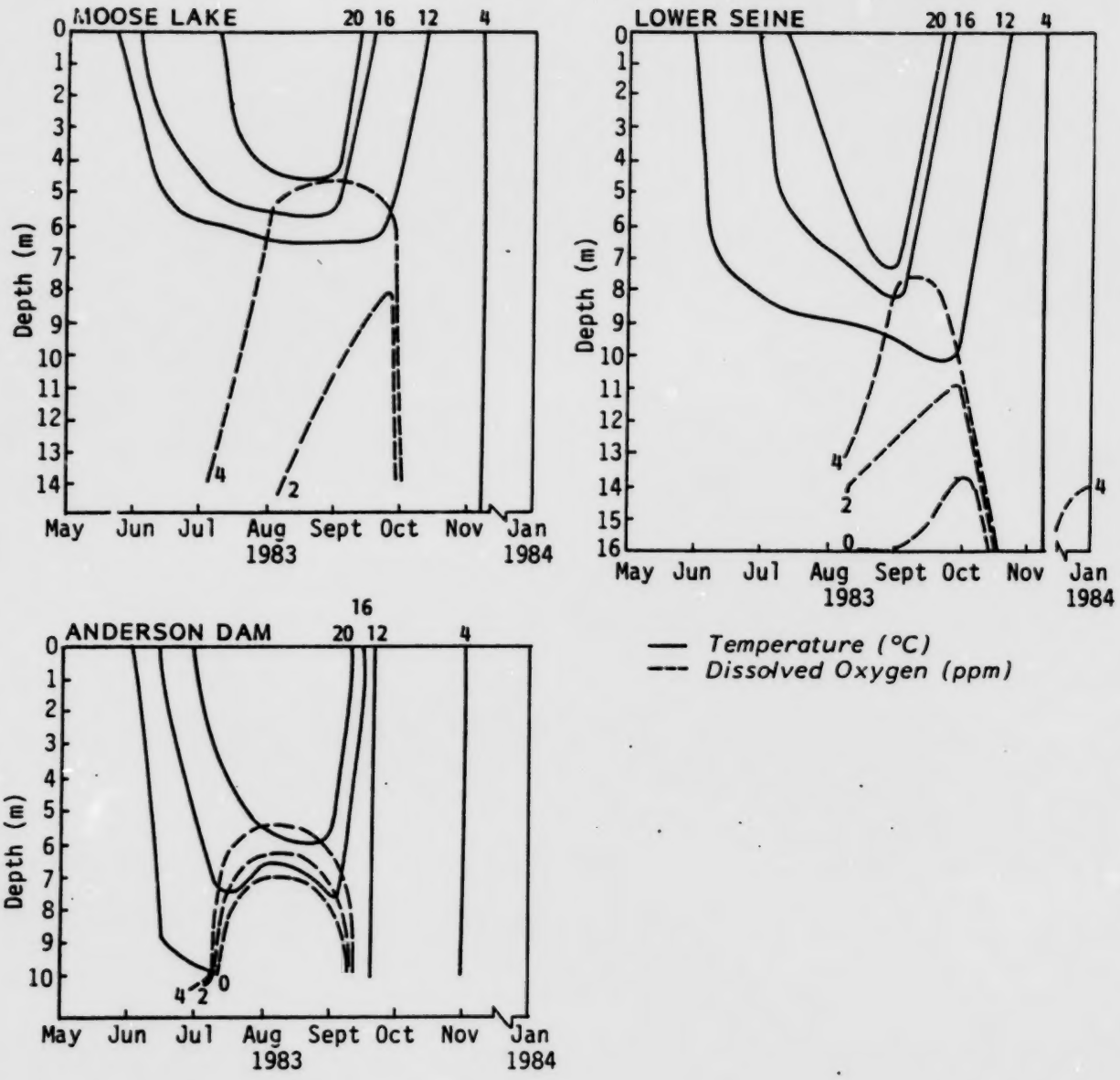


FIGURE 12

TEMPERATURE AND DISSOLVED OXYGEN LEVELS
IN MOOSE LAKE, LOWER SEINE LAKE AND AT ANDERSON DAM, 1983

TABLE 3

DEPTH OF (m) THERMOCLINE[1] ATIKOKAN 1983

Location	May	June	July	August	September		October
					Early	Late	
Snow Lake	*	6	5	5	6	9	*
Icy Lake	*	*	6	5	6	9	*
Abie Lake	*	*	5	6	6	*	*
Slush Lake	*	*	5	5	6	8	*
Marmion South	*	*	*	7	*	12	*
Marmion Central	*	*	*	7	8	*	-
Marmion North	*	*	8	*	8	12	*
Anderson Dam	*	*	8	6	8	*	*
Lower Seine	*	*	6	8	9	11	-
Moose Lake	*	*	6	6	6	8	-

[1] Thermocline defined as the depth at which the largest drop in temperature occurred (minimum of 3°C)

- no data

* no thermocline based on definition

at which zero oxygen concentration was recorded ranged from 12 to 14 m in Marmion Lake with the exception of Anderson Dam which was 7 m and from 5 to 7 m in the relatively shallow upper lakes. The depths in Moose and Slush Lakes were approximately 16 m (maximum depth of probe) and 12 m, respectively. These depths are remarkably similar to those recorded in 1981 with the exception of Moose Lake and Anderson Dam which were lower and higher, respectively. Moose Lake was drawn-down in 1981.

As in the previous years some oxygen depletion was apparent during the winter. Dissolved oxygen concentrations of less than 4 ppm were recorded near the bottom of Snow, Icy, Abie and Slush Lakes. In the Marmion Lake basins dissolved oxygen concentrations near the bottom were greater than 4 ppm unlike 1982 which were less than 4 ppm. This difference has been attributed to an earlier sampling visit in 1984 (January rather than February). Sampling at Anderson Dam and Moose Lake indicated abnormally high dissolved oxygen concentrations through the water column which was attributed to an instrument malfunction.

3.1.3 Transparency

Secchi depths measured during 1983 are listed in Table 4. Average Secchi depths ranged from 3.4 to 4.6 m with the exception of Snow Lake and Anderson Dam (2.0 m). Anderson Dam also had the lowest Secchi depth in 1981. The low transparency at Anderson Dam may reflect the construction activity in the area or the resuspension of the fine mine spoils in the area whereas the low Secchi depths in Snow Lake may be the result of construction activities and high productivity levels. As in 1981 lowest Secchi depths were recorded in the fall.

3.1.4 Water Chemistry

Surface and bottom water chemistry data collected in May, August and October of 1983 as well as in January of 1984 in Snow, Icy, Abie, Slush and Marmion (at Marmion South, Marmion North and Anderson Dam) Lakes are presented in Appendix 2. Mean levels in surface and bottom samples from each location as well as ranges of the parameters monitored are presented in Tables 5 and 6.

The study lakes were found to have higher nutrient (nitrate, phosphorus) and cation (calcium, magnesium, sodium and potassium) levels than the lakes of the experimental lakes area (ELA) of Northwestern Ontario examined by Armstrong and Schindler (1971) in 1968-1969. The water chemistry of our study lakes were similar to those of Canadian shield lakes or lakes with partial shield drainage (Armstrong and Schindler 1971). Similar observations were made based on 1981 and 1982 data (Ontario Hydro Research Division Report Nos 83-338-K and 84-54-K).

TABLE 4

SECCHI DEPTHS (m) MEASURED AT ATIKOKAN 1983

Location	May	June	July	Aug	Sept		Oct	Mean ± 1SD
					a	b		
Snow Lake	1.6	2.5	2.5	2.1	2.0	1.3	1.9	2.0 ± 0.4
Icy Lake	2.5	2.9	5.1	5.0	4.8	1.5	2.1	3.4 ± 1.5
Abie Lake	2.9	5.0	5.1	5.0	5.3	2.3	2.0	3.9 ± 1.5
Slush Lake	3.0	3.0	6.8	6.8	6.5	3.2	2.9	4.6 ± 2.0
Marmion South	3.0	4.2	5.6	4.0	5.3	3.0	2.0	3.9 ± 1.3
Marmion Central	2.5	3.5	5.0	6.5	4.8	2.8	-	4.2 ± 1.5
Marmion North	2.7	4.3	6.2	6.0	4.5	3.5	2.2	4.2 ± 1.5
Anderson Dam	1.9	3.0	2.9	1.5	2.3	1.3	0.9	2.0 ± 0.8
Lower Seine	3.0	4.5	3.5	3.8	3.5	3.0	-	3.6 ± 0.6
Moose Lake	3.2	3.5	4.5	3.5	3.5	3.2	-	3.6 ± 0.5
$\bar{X}$ ± 1 SD	2.6 ± 0.5	3.6 ± 0.8	4.7 ± 1.4	4.4 ± 18	4.3 ± 1.4	2.5 ± 0.8	2.0 ± 0.6	

Sept a First week in September
b Last week in September

TABLE 5

MEAN AND RANGE ( ) OF WATER CHEMISTRY PARAMETERS IN SURFACE SAMPLES COLLECTED AT ATIKOKAN MAY, AUGUST AND OCTOBER, 1983 AND JANUARY 1984

Parameter	Snow Lake	Icy Lake	Able Lake	Sluch Lake	Marmion Lake		
					South	North	Anderson Dam
Turbidity (NTU)	1.1 (0.6-1.7)	0.8 (0.3-1.2)	0.7 (0.4-1.0)[1]	1.2 (0.6-1.7)	0.6 (0.3-1.0)	0.8 (0.4-1.2)	1.1 (0.4-1.5)
Specific Conductance (mS/m)	12.9 (11.0-15.0)	16.0 (14.6-17.6)	13.7 (13.0-15.1)[1]	5.7 (5.1-7.3)	9.7 (9.1-11.0)	9.5 (8.8-10.6)	10.6 (9.6-11.7)
pH (at 25°C)	7.0 (6.7-7.3)	7.6 (7.4-8.0)	7.4 (7.2-7.5)	7.2 (7.0-7.3)	7.4 (7.2-7.7)	7.2 (7.0-7.5)	7.4 (7.0-7.6)
Total Hardness ($CaCO_3$, mg/L)	55.4 (45.0-65.5)	65 (56-73)	57 (53-65)[1]	23 (21-26)	40 (38-43)	39 (36-42)	43 (40-49)
Alkalinity (HCO_3 as $CaCO_3$, mg/L)[3]	48 (44-52)	64 (61-66)	53 (52-53)[2]	20 (9-24)	35 (34-37)	34 (33-35)	38 (36-39)
Filtrable Residues 105°C (mg/L)	85 (66-98)	102 (96-110)	93 (88-98)[1]	45 (28-54)	65 (52-74)	63 (56-71)	61 (34-94)
550°C (mg/L)	38 (16-64)	57 (34-78)	45 (22-64)[1]	17 (2-36)	26 (20-36)	31 (19-44)	30 (2-52)
Non-Filtrable Residues 105°C (mg/L)	<2 (<2-2)	<2 (<2)*	<2[1]	<2 (<2-2)	<2 (<2)*	<2	<2 (<2-2)
550°C (mg/L	<2 (<2)*	<2 (<2)*	<2[1]	<2	<2	<2	<2
Total Silica (mg SiO_2/L)	1.8 (0.6-2.9)	4.0 (2.4-5.2)	3.2 (2.0-4.4)	1.6 (1.3-2.1)	2.5 (1.8-3.0)	2.6 (1.8-3.0)	3.0 (2.5-3.3)
Soluble Silica (mg SiO_2/L)	1.6 (0.4-2.6)	4.2 (2.4-5.2)	2.9 (2.0-3.7)	1.5 (1.2-2.0)	2.4 (1.7-2.8)	2.4 (1.7-2.8)	2.5 (1.9-2.8)
Total Phosphorus (mg P/L)	0.017 (0.019-0.045)[4]	0.016 (0.006-0.027)	<0.012 (<0.005-016)[1]	0.010 (0.006-0.014)[4]	<0.010 (<0.005-0.015)	0.012 (<0.005-0.018)	<0.015 (<0.005-0.020)
Soluble Phosphate (mg P/L)	0.005 (0.004-0.005)	0.006 (0.003-0.011)	<0.004 (<0.005)*[1]	<0.005	<0.004 (<0.002-0.005)	<0.003 (<0.002-0.005)	<0.005 (<0.002-0.009)
Total Kjeldahl Nitrogen (mg/L)	0.55 (0.35-0.80)	0.50 (0.39-0.58)	0.44 (0.39-0.51)	0.35 (0.29-0.47)	0.32 (0.25-0.40)	0.37 (0.29-0.49)	0.46 (0.31-0.86)
Nitrate (mg NO_3/L)	0.22 (<0.01-0.75)	0.09 (<0.001-0.23)	<0.20 (<0.01-0.58)	<0.04 (<0.01-0.11)	<0.08 (<0.01-0.14)	0.36 (<0.01-1.38)	<0.03 (<0.01-0.08)
Total Organic Carbon (mg/L)	11 (9-13)	10 (4-13)	12 (8-14)[1]	8 (6-10)	9 (6-11)	8 (7-9)	8 (5-10)
Total Inorganic Carbon (mg/L)	11 (11-12)	16 (13-20)	12 (11-13)[1]	6 (5-7)	9 (8-11)	9 (8-11)	10 (8-11)
Sulphate (mg SO_4/L)	6.6 (5.9-7.6)	4.7 (4.0-5.3)	4.8 (4.7-4.9)[1]	2.4 (2.2-2.8)	7.3 (6.3-8.3)	7.8 (7.1-8.8)	8.7 (7.7-9.7)
Chloride (mg/L)	4.9 (3.2-7.3)	8.0 (7.1-9.3)	6.0 (4.1-8.9)[1]	1.0 (0.20-2.74)	2.1 (1.5-3.6)	2.1 (1.4-3.9)	2.3 (1.7-4.0)
Ammonia (mg/L)	<0.04 (<0.01-0.11)	<0.03 (<0.01-0.08)	<0.03 (<0.01-0.08)	<0.02 (<0.01-0.03)	<0.02 (<0.01-0.03)	<0.02 (<0.01-0.04)	0.02 (<0.01-0.06)
Calcium (mg/L)	18.0 (14.7-21.3)	20.1 (16.9-22.6)	17.4 (16.3-19.9)	7.7 (7.0-8.5)	11.1 (10.6-12.4)	10.8 (10.0-11.8)	12.0 (11.0-14.0)
Magnesium (mg/L)	2.6 (2.1-3.0)	3.7 (3.4-4.1)	3.4 (3.0-3.9)	1.0 (0.92-1.2)	2.9 (2.6-3.0)	2.9 (2.7-3.1)	3.2 (3.0-3.6)
Sodium (mg/L)	3.0 (2.3-3.8)	4.6 (4.0-5.4)	3.7 (3.2-4.6)	0.7 (0.6-0.8)	2.1 (1.9-2.3)	2.0 (1.8-2.3)	3.1 (2.0-6.1)
Potassium (mg/L)	1.10 (0.92-1.37)	0.96 (0.74-1.16)	0.93 (0.83-1.15)	0.40 (0.37-0.48)	0.73 (0.68-0.81)	0.76 (0.68-0.90)	0.87 (0.70-1.28)
Filtrable Iron (mg/L)	0.063 (0.047-0.104)	0.056 (0.032-0.101)	0.041 (0.024-0.062)	0.046 (0.032-0.075)	0.033 (0.016-0.040)	0.048 (0.022-0.086)	0.067 (0.031-0.113)
Total Iron (mg/L)	<0.06 (<0.05-0.07)	<0.05	<0.05 (<0.05-0.05)	<0.05 (<0.05-0.05)	<0.05 (<0.05-0.05)	<0.05	0.07 (<0.05-0.10)
Nickel (mg/L)	<0.006 (<0.005-0.008)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Aluminum (mg/L)	<0.5	<1	<1	<1	<1	<1	<1
Copper (mg/L)	<0.002 (<0.001-0.003)	<0.001 (<0.001-0.001)	<0.001 (<0.001-0.002)	<0.001 (<0.001-0.002)	<0.001 (<0.001-0.002)	<0.001 (<0.001-0.002)	<0.001 (<0.001-0.002)
Zinc (mg/L)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02 (<0.02-0.02)	<0.02
Manganese (mg/L)	<0.06 (<0.05-0.08)	<0.06 (<0.05-0.10)	<0.06 (<0.05-0.08)	<0.05	<0.03 (<0.05-0.14)	<0.06 (<0.05-0.07)	<0.05 (<0.05-0.05)
Mercury (Filtered) (mg/L)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Arsenic (mg/L)	<0.001 (<0.001-0.002)	<0.001 (<0.001-0.002)	<0.001 (<0.001-0.001)	<0.001	<0.001	<0.001	<0.001
Selenium (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

1 May, October and January data only
2. May, October, and August data only
3 Surface to Bottom Samples
4 August, October and January data only
* Value represents highest detection level

85-81

TABLE 6

MEAN AND RANGE ( ) OF WATER CHEMISTRY PARAMETERS IN BOTTOM SAMPLES COLLECTED AT ATIKOKAN BAY, AUGUST AND OCTOBER, 1983 AND JANUARY 1984

Parameter	Snow Lake	Icy Lake	Able Lake	Slush Lake	Marmion Lake		
					South	North	Anderson Dam
Turbidity (NTU)	1.0 (0.6-1.2)	0.9 (0.5-1.4)	0.8 (0.4-1.3)	1.6 (0.8-2.3)	0.9(0.5-1.3)	0.7 (0.4-1.2)	2.4 (0.6-6.4)
Specific Conductance (mS/m)	13.3 (11.0-16.5)	18.4 (16.0-23.3)	13.4 (13.0-14.5)	5.6 (5.3-5.9)	9.6 (9.0-10.5)	9.7 (8.8-11.0)	10.1 (9.5-11.3)
pH (at 25°C)	7.3 (7.0-7.8)	7.3 (7.0-7.4)	7.2 (7.0-7.4)	6.8 (6.6-7.2)	7.2 (7.0-7.3)	7.0 (6.7-7.2)	7.1 (6.7-7.4)
Total Hardness ($CaCO_3$, mg/L)	57 (45-71)	69 (70-76)	57 (51-61)	24 (22-27)	40 (38-41)	39 (36-41)	43 (40-45)
Filtrable Residues 105°C (mg/L)	86 (66-106)	104 (94-112)	90 (86-96)	46 (40-50)	65 (58-70)	61 (50-76)	73 (60-86)
550°C (mg/L)	47 (20-68)	58 (44-70)	51 (30-56)	18 (<1-32)	28 (24-34)	22 (4-32)	26 (8-36)
Non-Filtrable Residues 105°C (mg/L)	<2 (<2-2)	<2 (<2)[a]	<2 (<2-2.0)	<4 (<2-7)	<2 (<2-2)	<2 (<2)[a]	<3 (<2-5)
550°C (mg/L)	<2 (<2)[a]	<2 (<2)[a]	<2	<2 (<2-2)	<2 (<2)[a]	<2	<2 (<1-2)
Total Silica (mg SiO_2/L)	1.9 (1.4-2.4)	5.4 (4.2-6.8)	3.7 (2.8-6.5)	2.4 (1.9-3.0)	3.1 (2.6-3.5)	3.0 (2.7-3.4)	5.0 (3.5-9.0)
Soluble Silica (mg SiO_2/L)	1.5 (1.0-2.0)	5.3 (4.2-6.6)	3.2 (2.7-3.7)	2.3 (1.9-2.8)	2.8 (2.5-3.2)	2.9 (2.6-3.0)	3.1 (2.6-4.4)
Total Phosphorus (mg P/L)	0.017 (0.013-0.022)	<0.016 (<0.005-0.032)	0.015 (0.011-0.021)[1]	0.022 (0.008-0.053)	<0.014 (<0.005-0.040)	<0.012 (<0.005-0.016)	0.031 (0.013-0.056)
Soluble Phosphorous (mg P/L)	<0.004 (<0.005)[a]	<0.006 (<0.005-0.009)	<0.004 (<0.005)[a]	<0.005 (<0.002-0.007)	<0.004 (<0.005-0.005)	<0.003 (<0.002-0.005)	<0.004 (<0.002-0.006)
Total Kjeldahl Nitrogen (mg N/L)	0.50 (0.41-0.56)	0.49 (0.42-0.61)	0.43 (0.36-0.48)	0.37 (0.31-0.43)	0.31 (0.25-0.33)	0.31 (0.25-0.36)	0.35 (0.33-0.37)
Nitrate (mg NO_3/L)	<0.43 (<0.01-1.16)	<0.10 (<0.01-0.35)	<0.20 (<0.01-0.71)	<0.24 (<0.01-0.88)	<0.03 (<0.01-0.06)	<0.03 (<0.01-0.04)	<0.02 (<0.01-0.03)
Total Organic Carbon (mg/L)	11 (8-14)	11 (5-13)	11 (8-12)	9 (7-11)	8 (6-10)	7 (5-9)	12 (5-25)
Total Inorganic Carbon (mg/L)	11 (11-12)	16 (14-20)	13 (12-14)	6 (5-7)	9 (7-11)	9 (8-10)	10 (8-11)
Sulphate (mg SO_4/L)	7.1 (6.0-8.4)	4.4 (3.8-5.1)	4.6 (4.2-4.9)	2.1 (1.7-2.3)	7.9 (7.0-8.4)	8.2 (7.7-8.8)	9.0 (7.9-9.4)
Chloride (mg/L)	5 (3.1-7.9)	7.5 (5.5-9.0)	5.5 (4.1-8.2)	0.7 (0.3-1.4)	2.6 (1.5-4.9)	1.9 (1.4-2.5)	2.3 (1.4-4.0)
Ammonia (mg/L)	<0.05 (<0.01-0.11)	<0.04 (<0.01-0.06)	<0.04 (<0.01-0.08)	<0.02 (<0.01-0.04)	<0.02 (<0.01-0.03)	<0.02 (<0.01-0.04)	<0.02 (<0.01-0.03)
Calcium (mg/L)	18.1 (14.6-23.0)	21.0 (2.0-22.3)	17.1 (15.7-18.6)	7.9 (7.3-8.3)	11 (10.6-11.5)	10.8 (10.0-11.5)	12.0 (11.8-13.0)
Magnesium (mg/L)	2.6 (2.1-3.2)	3.9 (3.5-4.0)	3.3 (2.9-3.6)	1.0 (1.0-1.2)	2.9 (2.7-3.0)	2.9 (2.7-3.0)	3.3 (3.0-3.4)
Sodium (mg/L)	2.9 (2.2-3.8)	4.6 (4.2-5.0)	3.6 (3.1-4.2)	0.7 (0.6-0.8)	2.0 (1.9-2.2)	2.0 (1.9-2.2)	2.2 (2.0-2.3)
Potassium (mg/L)	1.08 (0.92-1.37)	1.01 (1.00-1.06)	0.88 (0.84-0.92)	0.42 (0.37-0.45)	0.72 (0.68-0.75)	0.72 (0.70-0.74)	0.83 (0.77-0.86)
Filtrable Iron (mg/L)	0.059 (0.019-0.095)	0.089 (0.022-0.120)	0.79 (0.059-0.102)	0.112 (0.059-0.190)	0.060 (0.017-0.120)	0.069 (0.017-0.134)	0.847 (0.021-3.200)
Total Iron (mg/L)	<0.07 (<0.05-0.10)	<0.06 (<0.05-0.10)	<0.08 (<0.05-0.10)	0.18 (0.05-0.34)	< 0.05 (<0.05-0.06)	<0.05 (<0.05-0.05)	<0.18 (<0.05-0.50)
Nickel (mg/L)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Aluminum (mg/L)	<0.5	<1	<1	<1	<1	<1	<1
Copper (mg/L)	<0.002 (<0.001-0.003)	<0.001 (<0.001-0.002)	<0.001 (<0.001-0.002	<0.001 (<0.001-0.002)	< 0.001 (<0.001-0.002)	<0.001 (<0.001-0.002)	<0.002 (<0.001-0.003)
Zinc (mg/L)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Manganese (mg/L)	<0.28 (<0.05-0.85)	0.84 (0.08-2.14)	<0.15 (<0.05-0.32)	<0.31 (<0.05-0.90)	< 0.09 (<0.05-0.13)	<0.06 (<0.05-0.09)	<0.12 (<0.05-0.33)
Mercury (Filtered, mg/L)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Arsenic (mg/L)	<0.002 (<0.001-0.003)	<0.002 (<0.001-0.003)	<0.001 (<0.001-0.002)	<0.001 (<0.001-0.001)	<0.001	<0.001	<0.001 (<0.001-0.001)
Selenium (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

1 August, October and January Data Only
a Value represents highest dectection level

As in the previous two years the lakes were found to have low alkalinity with moderate levels of nutrients and ions. With the exception of iron the remaining metals monitored were generally found in levels close to or below their respective detection levels. Iron, copper and manganese were the only metals present in detectable levels at all seven sampling locations.

The pH of the lakes were generally close to 7.0 with mean surface pH ranging from 7.0 at Snow Lake to 7.6 at Icy Lake and mean bottom pH ranging from 6.8 at Slush Lake to 7.3 at Snow and Icy Lakes.

In most cases pH was higher in May, August and October of 1983 than in the corresponding months in 1982, which in turn were higher than those observed in 1981. In the 1982 report (Ontario Hydro Research Division Report No 84-54-K) it was suggested that the difference in pH observed in 1981 and 1982 may have been due to differences in sampling times. However in 1983 water chemistry samples were collected in the same months as in 1982 and higher pH values were again observed indicating that the changes in pH may be real. Despite the change in pH, no differences were obvious in the levels of parameters associated with lake pH such as alkalinity, total hardness, and carbon.

The pH of Snow, Icy and Marmion Lakes monitored by Acres (Acres, 1976) from May 1975 to April 1976 were comparable to either our 1982 or 1983 pH values. Abie Lake appears to be an exception with a lower mean pH in 1975-1976 than in 1982 and 1983. Data collected by Ontario Hydro in 1979 (Ontario Hydro Research Division Report No C79-128-K) indicated that the pH values were comparable to those found in 1975-1976 (Acres 1976) and in 1982 (Ontario Hydro Research Division Report No 84-54-K). Lower Seine, Icy and Marmion Lakes, the three lakes studied both in 1975-1976 (Acres 1976) and in 1981 (Ontario Hydro Research Division Report No 83-338-K) had higher pH values in 1975-1976 than in 1981. Thus it appears as though the low pH values encountered in 1981 were probably exceptional for the study lakes.

Levels of Kjeldahl nitrogen and silica were generally higher in 1983 than they were in 1982. At the surface mean Kjeldahl nitrogen levels ranged from 0.32 mg/L at Marmion South to 0.55 mg/L at Snow Lake and at the bottom they ranged from 0.31 mg/L at Marmion South and North to 0.5 mg/L at Snow Lake. Mean total silica levels at the surface and bottom ranged from 1.6 and 2.4 mg/L, respectively at Slush Lake to 4.2 and 5.3 mg/L at Icy Lake. Total phosphorus at the surface ranged from less than 0.01 mg/L at Marmion South to 0.017 mg/L in Snow Lake. At the bottom phosphorus levels ranged from 0.012 mg/L at Marmion North to 0.031 mg/L at Anderson Dam. Phosphorus levels in Snow

Lake, into which sewage was discharged during this study period, was higher on most sampling occasions than it had been in 1981 and 1982. However, higher 1983 phosphorus levels compared to 1981 and 1982 levels were also recorded sporadically in the remaining lakes.

Comparison of Lakes

The lakes were clear with mean turbidity measurements of less than 2.0 NTU at all locations except near the bottom at Anderson Dam where the mean turbidity was 2.4 NTU.

Generally levels of many of the parameters monitored were higher in Snow, Icy, and Abie Lakes than in Slush Lake and at Marmion Lake locations.

Icy Lake had the highest levels of a large number of the parameters measured. Specific conductance, which gives a measure of the total amount of ionized material in the water, and levels of the ions calcium, magnesium, sodium, and chloride were all higher in Icy Lake than in the remaining lakes. At the surface of Icy Lake the levels were 16.0 mS/m, and 20.1, 3.7, 4.6, and 8.0 mg/L, respectively, and at the bottom they were 18.4 mS/m, and 21.0, 3.9, 4.6, and 7.5 mg/L. Total hardness, pH, alkalinity and total inorganic carbon were also highest in Icy Lake. At the surface their mean values were 65, 7.6, 64 and 16 mg/L, respectively. Near the bottom mean pH was 7.3, mean total hardness was 69 mg $CaCo_3$/L, and mean inorganic carbon was 16 mg/L. Mean levels of filtrable residues (102 and 104 mg/L at the surface and bottom, respectively) and total (4.2 and 5.4 mg/L) and soluble silica (4.2 and 5.3 mg/L) levels were also highest in Icy Lake. Icy Lake also had the highest bottom level of manganese (0.84 mg/L).

Slush Lake had the lowest levels of many of the parameters measured. It had the lowest specific conductivity and levels of calcium, magnesium, sodium, potassium, sulphate and chloride. Their mean surface levels were 5.7 mS/m and 7.7, 1.0, 0.7, 0.40, 2.4 and 1.0 mg/L, respectively, and bottom levels were 5.6 mS/m and 7.9, 1.0, 0.7, 0.42, 2.1 and 0.7 mg/L. Total hardness (23 and 5.6 mg $CaCo_3$/L at the surface and bottom, respectively), alkalinity (20 mg $CaCo_3$/L) and inorganic carbon (6 mg/L both at surface and bottom) were also lowest. Slush Lake had the lowest bottom pH (6.8). Levels of filtrable residues (45 and 46 mg/L at the surface and bottom, respectively) were also lowest in this lake.

Highest levels of most water chemistry parameters in Icy Lake and lowest levels in Slush Lake were also observed in 1982.

Anderson Dam had the highest levels of total and suspended iron with substantially higher levels of suspended iron found near the bottom in August (3.2 mg/L). This high level of suspended iron may have been the result of the breaching of Anderson Dam which resulted in the release of iron rich material into the water from the dam itself or by suspension of bottom sediments due to the disturbance.

Snow Lake had the highest levels of Kjeldahl nitrogen, nitrate and ammonia. Their mean surface levels in this lake were 0.55, 0.22 and 0.04 mg/L, respectively, and bottom levels were 0.50, 0.43 and 0.05 mg/L.

Sewage effluent seeped into Snow Lake during this study year and microbiological parameters monitored (Table 7) were described by MOE as highly irregular and suggestive of some non-human source of bacterial contamination. Samples for measurements of total coliforms, background colonies, fecal coliforms and fecal Streptococci were taken at three locations. Site 1 was right at the sewage discharge point, Site 2 was slightly removed from the discharge, while Site 3 was at the surface at the deepest point of the lake. Total coliforms were high (>15 000/100 mL) at all three sites and exceeded the level (1 000/100 mL) at which MOE (1978) considered water quality to be impaired. Fecal coliforms at Site 1 (120/100 mL) exceeded the level at which a potential health hazard exists (100/100 mL, MOE 1978). The fecal Streptococci count at Site 1 was exceptionally high (>1 500/100 mL) and the ratio between the fecal coliform and fecal Streptococci counts was 0.08. A ratio less than 0.7 suggests that the discharge is non-human in origin.

The biological oxygen demand at Sites 1, 2, and 3 were 20, 2, and 2 mg/L, respectively (Table 7). The oxygen level recorded at the surface of the water column at Site 3 in August, at 8.3 mg/L, was well in excess of the BOD. Total Kjeldahl nitrogen and total phosphorus levels were substantially higher at Site 1 (4.1 and 1.13 mg/L, respectively) than at Sites 2 (0.48 and 0.02 mg/L) and 3 (0.47 and 0.13 mg/L, respectively).

3.2 Biological Characteristics

3.2.1 Macrophytes

Species Composition

A list of the species found in 1983 and the lakes in which they occurred is presented in Table 8. Twenty-nine of the species are submergents and floating leafed species, seven are emergents and three are macrophytic algae (Charophytes) (two were unidentified). All species, except one Charophyte which occurred in the vicinity of Anderson Dam on Marmion Lake, were previously observed in the study area in either 1981 or 1982.

TABLE 7

LEVELS OF MICROBIOLOGICAL PARAMETERS, BIOLOGICAL OXYGEN DEMAND (BOD), TOTAL KJELDAHL NITROGEN AND TOTAL PHOSPHORUS AT THREE DISTANCES FROM THE SEWAGE DISCHARGE SOURCE IN SNOW LAKE ON AUGUST 8, 1983

	Site 1	Site 2	Site 3	Baseline*
Microbiological Parameters				
Total Coliform Counts	>15 000	>15 000	>15 000	1 000
Background Colonies	70 000	13 000	6 000	N/A
Fecal Coliforms	120	<10	<10	100
Fecal Streptococcus	>1 500	<10	-10	N/A
BOD (mg/L)	20	2	2	N/A
Total Kjeldahl Nitrogen (mg/L)	4.10	0.48	0.47	N/A
Total Phosphorus (mg/L)	1.13	0.02	0.13	N/A

*Minimum acceptable value for body contact

TABLE 8

MACROPHYTE SPECIES LIST FOR THE ATIKOKAN STUDY LAKES - 1983

	Snow	Icy	Abie	Slush	Marmion
Brasenia schreberi Gmel.			X		
Callitriche hermaphroditica L.	X	X			X
Ceratophyllum demersum L.	X				X
Eleocharis acicularis (L.) R. & S.	X				
E. paulustris (L.) R. & S.					X
Elodea canadensis (Michx.) Rich.	X	X			X
Glyceria borealis (Nash.) Batch.	X		X		X
G. grandis S. Watson				X	
Hippurus vulgaris L.				X	
Lemna sp	X				
Myriophyllum alterniflorum D.C.			X		X
M. exalbescens (Fern.)	X	X	X		X
Najas flexilis (Wild.) Rosth & Schmidt	X	X	X	X	X
Nuphar sp			X	X	
Nymphaea odorata Ait.		X	X	X	X
Polygonum natans Eat.			X		
P. amplifolius Tuckerm.	X			X	X
P. epihydrus Raf.	X	X			X
P. foliosus Raf.	X	X			X
P. friesii Rupr.			X		
P. gramineus L.		X	X		X
P. natans L.		X			
P. obtusifolius Mert & Koch	X				
P.pectinatus L.		X			
P. praelongus Walfen.					X
P. pusillus L.	X				
P. richardsonii (Benn.) Rydb.	X	X	X	X	X
P. robbinsii Oakes.	X	X	X	X	
P. spirillus Tuckerm.					X
P. zosteriformis Fern.		X			X
Ranunculus tricophyllus Chaix	X	X	X		X
Sagittaria spp	X	X	X	X	X
Scirpus cyperinus (L.) Kunth	X			X	
Typha spp	X	X	X	X	X
Ultricularia vulgaris L.			X		
Vallisneria americana Michx.	X	X	X		
Charophytes					
Chara sp	X	X	X		
unidentified Charophytes	X			X	
Total Number of Species	22	17	18	12	21

Distribution and Abundance

The vegetation in the selected bays is described in terms of the zonal pattern which is usually present in temperate lakes. Three zones associated with changes in water depth are generally recognized, but all are not necessarily present in every lake. These zones include a zone of emergent species in shallow water near shore, a zone of floating leafed species in deep water and a zone of submergent species in deeper water still (Curtis 1959).

Snow Lake

The species present along the four transects in Snow Lake are shown in Table 9 and the vegetation is mapped in Figure 13. The overall species composition changed little since 1982 although some differences between the two years were apparent on individual transects (Table 9). The emergent vegetation was dominated by *Typha* sp (cattails) which had increased from the 10 - 15% cover observed in 1982 to 25 - 100% in 1983. The outer edge of the cattail band was in standing water. *Eleocharis acicularis*, a low growing spike rush, had colonized this area and formed a carpet in between the cattail stems. The most common submergents were *Elodea canadensis* (waterweed), *Potamogeton pusillus* (a pondweed) and *Najas flexilis* (bushy pondweed). These are similar to those observed in 1982, but the spatial patterns in species distribution in 1983 were less heterogeneous than those observed in 1982. The first 3 - 40 m on each transect were bare (transect 3) or sparsely (<25%) covered (transects 1, 2, 4). The sparse cover on transects 1, 2 and 4 may be a reflection of the fact that at least part of these areas was only recently flooded. *Najas flexilis* was generally the dominant and was mixed with occasional individuals or patches of *Sagittaria* sp (arrowhead), *Potamogeton pusillus*, *Elodea canadensis* or *Vallisneria americana* (wild celery). The absence of cover on the first few meters of transect 3 is a consequence of the bedrock substrate. Cover in the remaining parts of the transects (except the bare area on transect 1, indicated in Figure 13) was around 100%. *Najas flexilis* was the dominant for the first few metres in the densely vegetated area of the first transect and for 20 m of the second transect. On the second transect *Chara* sp (stonewort) was second in importance accounting for 20% of the total bottom cover. *Ranunculus tricophyllus* (crowfoot), *Elodea canadensis*, *Potamogeton pusillus* and *P. robbinsii* were also present, collectively contributing 5% to the total cover. The *Najas* zone on transects 1 and 2 and the zone of sparse cover on transect 4 were replaced by a zone dominated or co-dominated by *Elodea canadensis*. This zone covered the remaining vegetated areas on transects 1, 2, and 4. The *Elodea* occurred either alone or in mixtures with *Potamogeton robbinsii*, *P. pusillus*,

TABLE 9

MACROPHYTE SPECIES PRESENT ALONG THE TRANSECTS IN SNOW LAKE

Transect	1		2		3		4	
Year	1982	1983	1982	1983	1982	1983	1982	1983
Callitriche hermaphroditica						X		
Eleocharis acicularis				X				
Elodea canadensis	X	X	X	X	X	X	X	X
Glyceria borealis				X				
Myriophyllum exalbescens						X		
Najas flexilis		X	X	X	X	X	X	X
Potamogeton epihydrus					X			
[1] *P. foliosus*	X		X		X		X	
P. obtusifolius	X		X			X		X
[1] *P. pusillus*		X		X		X		X
P. richardsonii						X		
P. robbinsii	X	X	X	X		X		X
Ranunculus tricophyllus			X	X				
Sagittaria sp		X						
Typha sp			X	X				
Vallisneria americana		X						
Chara sp			X	X		X		
Unidentified Charophyte						X		

[1] The distinction between these species is not clear cut. It is possible that in the field there is a mixture of the two species.

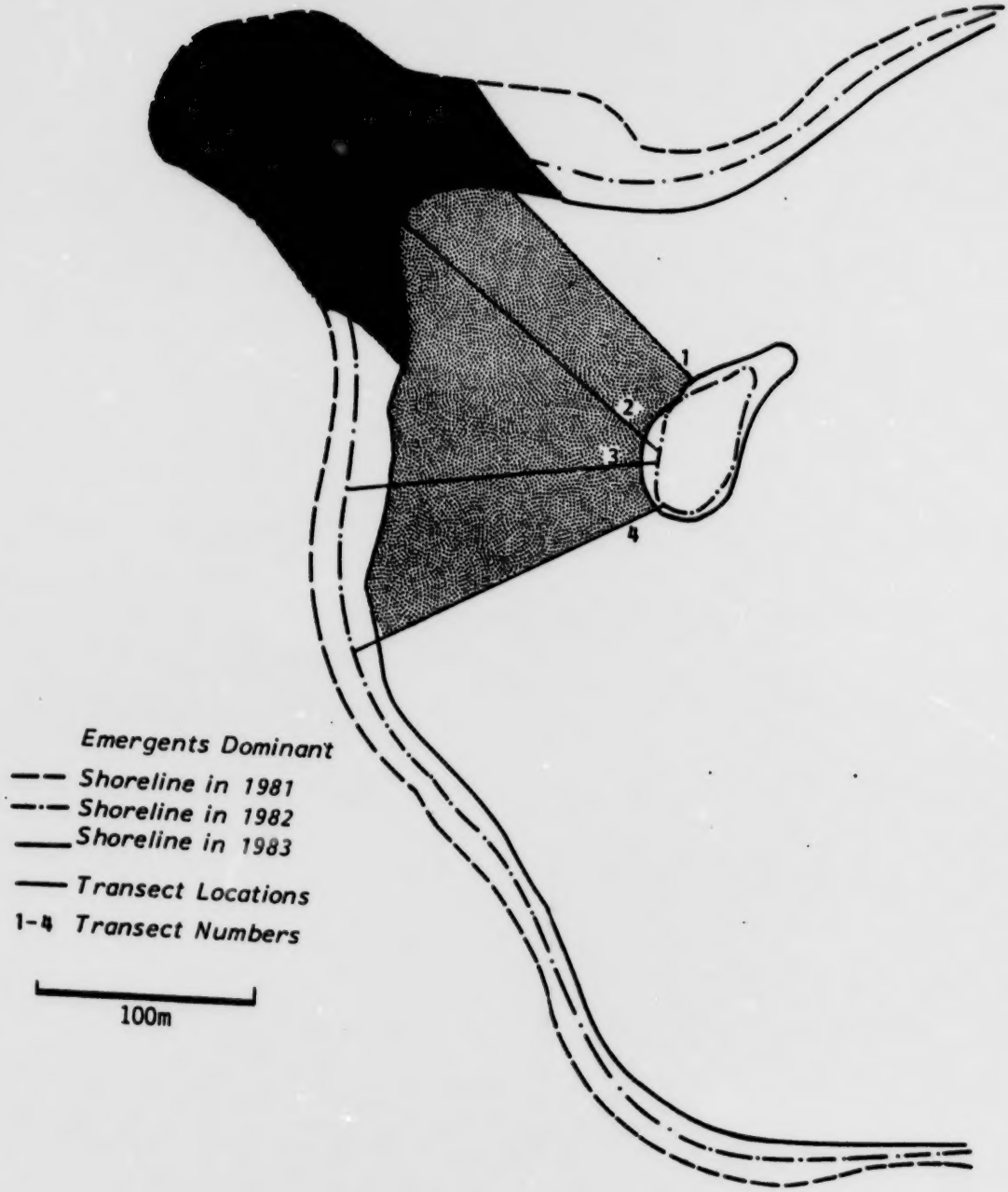


FIGURE 13
MACROPHYTE DISTRIBUTION IN THE SNOW LAKE STUDY AREA - 1983

P. obtusifolius and *Najas flexilis*. This zone was also prominent on the fourth transect beginning at about 2 m offshore of the mainland and extending almost to the island. The zone in between the bare zone and the *Elodea* zone on the fourth transect was unique among the zones on the four transects and consisted of *Potamogeton robbinsii* (75% bottom cover) mixed with *P. richardsonii* (approximately 25% bottom cover) and a small amount of *Callitriche hermaphroditica* (water starwort).

A survey of part of the remaining shoreline of Snow Lake revealed that macrophytes had colonized areas that were not vegetated or only sparsely vegetated in 1982 (Figure 14). *Elodea canadensis* appeared to be the most abundant species forming a discontinuous band around the lake in water 1 - 3 m deep. Other species present included *Potamogeton pusillus, P. robbinsii, P. amplifolius, P. richardsonii, Najas flexilis, Chara* sp and *Myriophyllum exalbescens* (water milfoil). The increase in abundance of *Elodea* in Snow Lake is important since the species is potentially problematic. Following the commissioning of the Wabamun Generating Station and Sundance Power Plant in Alberta, *Elodea canadensis* increased in biomass and extended its distribution to such an extent that it became a recreational nuisance (Haag and Gorham 1977). The species is well adapted to spreading by vegetative means since the stems are easily broken and readily form adventitious roots (St. John 1965). The species' proliferation in Lake Wabamun was attributed in part to its ability to form large rafts of detached stems on the water surface (Alberta Energy Resources Conservation Board 1981) and to its lack of a dormancy mechanism which permitted growth during winter and gave it a competitive advantage over species which went dormant (Haag and Gorham loc cit).

In addition to *Elodea canadensis*, epiphytes increased markedly since 1982. Large algal mats were seen floating on the surface of the lake and draped across the stems of the submersed macrophytes. The species of epiphytes were not identified. Their increase was likely due to the seepage of sewage into a stream draining into Snow Lake.

Icy Lake

The West Bay

In order to provide better coverage of this bay two new transects were surveyed in 1983 (#16, #17, Figure 15, Table 10). The species present along the transects are shown in Table 10 and the vegetation is mapped in Figure 15. The emergent and floating leafed vegetation had not obviously changed in distribution or composition since 1982. *Typha* sp was still the dominant emergent forming an intermittent band at several points

FIGURE 14

DISTRIBUTION OF ELODEA CANADENSIS IN SNOW LAKE

(AREA BETWEEN THE ARROWS WAS NOT SURVEYED)

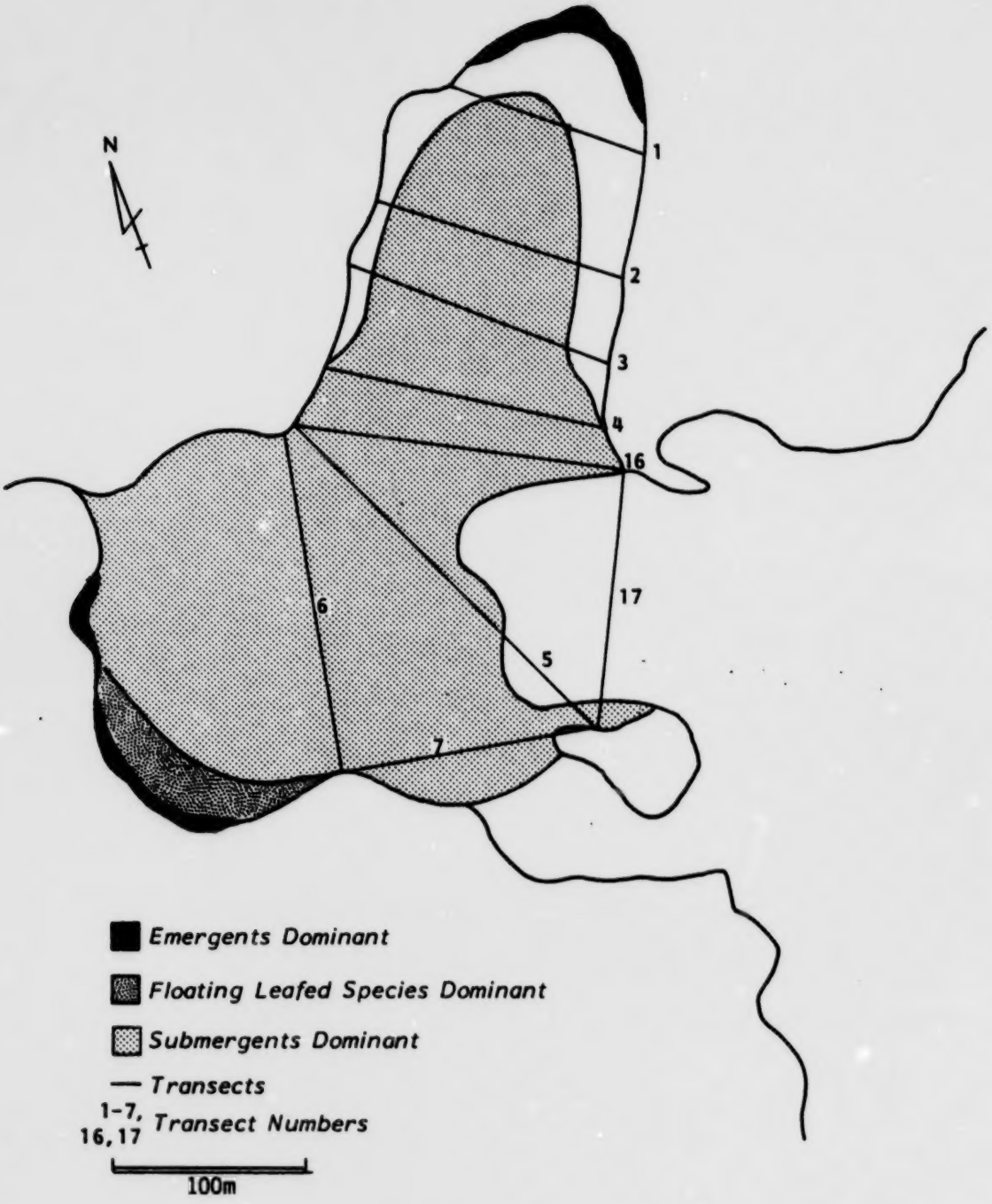


FIGURE 15

MACROPHYTE DISTRIBUTION IN THE WEST BAY OF ICY LAKE - 1983

TABLE 10

MACROPHYTES PRESENT ALONG THE TRANSECTS IN THE WEST BAY OF ICY LAKE

Transect	1		2		3		4		5		6		7		16		17	
Year	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983
Elodea canadensis			X		X					X					no		no	X
Myriophyllum exalbescens							X	X	X	X			X		data	X	data	X
Najas flexilis			X		X													
Nymphaea odorata		X		X		X												
Potamogeton epihydrus									X									
P. friesii							X		X									
P. gramineus								X								X		
P. pectinatus				X														
P. richardsonii			X		X	X				X		X		X				
P. robbinsii	X	X	X	X	X	X	X	X		X	X	X	X	X		X		X
P.nstrictifolius			X		X				X									
Ranunculus tricophyllus		X		X			X	X				X		X		X		X
Sagittaria sp		X				X												
Vallisneria americana														X				
Chara sp			X		X		X	X		X		X		X				X

on the shore while *Nymphaea odorata* (white water lily), the most common floating leafed species, was patchily distributed at the edge of the *Typha* bands. The composition of the submergent vegetation was similar to that observed in 1982 with *Potamogeton robbinsii* being the most widespread and generally most abundant species throughout most of the bay. It occurred alone and in mixtures with a variety of species including *P. richardsonii*, *P. gramineus*, *Ranunculus tricophyllus* and *Myriophyllum exalbescens*. Two other cover types observed in 1982 included large patches of *Chara* sp and large patches of mixed species dominated by *Myriophyllum exalbescens*. These respectively occurred in shallow (<1 m) and deep (>1 m) water. In 1983 both cover types were present, although *Chara* sp appeared to be more common in 1983 than in 1982 and *Myriophyllum exalbescens*, less common. Such changes could reflect changes in the position of the transects, although efforts had been made to locate the transects at prominent points along the shore. Overall, the area occupied by submergents increased since 1982, largely due to colonization of the north ends of Transects 5 and 6 by *Potamogeton robbinsii*.

The East Bay

The species found along the transects in the east bay of Icy Lake are listed in Table 11 and the distribution of large patches (>4 m in diameter) of macrophytes is shown in Figure 16. The vegetation in this bay has undergone a dramatic decrease in total cover since 1982. With the exception of the large patches where the cover was greater than 50%, the vegetation on all transects consisted of isolated individuals or small clumps of the species indicated in Table 11. The average cover was less than 1%. The large patches were generally dominated by a single species rather than being composed of species mixtures. The dominants included *Najas flexilis*, *Nymphaea odorata* and *Potamogeton robbinsii*. The reasons for the decline of the vegetation in this bay are not known; however, lower water levels in Icy Lake in 1982 may have resulted in substantial winter-kill and a consequent reduction in macrophytes as observed in 1983.

Abie Lake

The species present in the bay surveyed in Abie Lake are listed in Table 12 and the macrophyte distribution is mapped in Figure 17. As in 1982, vegetation was present throughout the entire bay, except on the east shore where the substrate was dominated by boulders. The overall species composition was similar to that observed in 1982 (Table 12), although individual transects exhibited some differences between the two years (Table 12). Spatially, four zones were present in 1982, namely;

TABLE 11

MACROPHYTES PRESENT ALONG THE TRANSECTS IN THE EAST BAY OF ICY LAKE

Transect	8		9		10		11		12		13		14		15	
Year	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983
Callitriche hermaphroditica								X								
Myriophyllum exalbescens		X							X		X		X		X	
Najas flexilis	X	X	X	X	X			X	X	X						
Nymphaea odorata	X	X		X	X	X		X	X	X				X		
Potamogeton foliosus								X								
P. natans										X						
P. pectinatus		X														
P. richardsonii			X											X		X
P. robbinsii		X	X	X	X	X	X	X	X	X	X		X	X	X	X
P. strictifolius	X								X							
P. zosteriformis																X
Ranunculus tricophyllus		X		X		X		X		X				X		
Sagittaria sp		X		X				X								
Typha sp								X								
Vallisneria americana													X			
Chara sp		X							X				X			

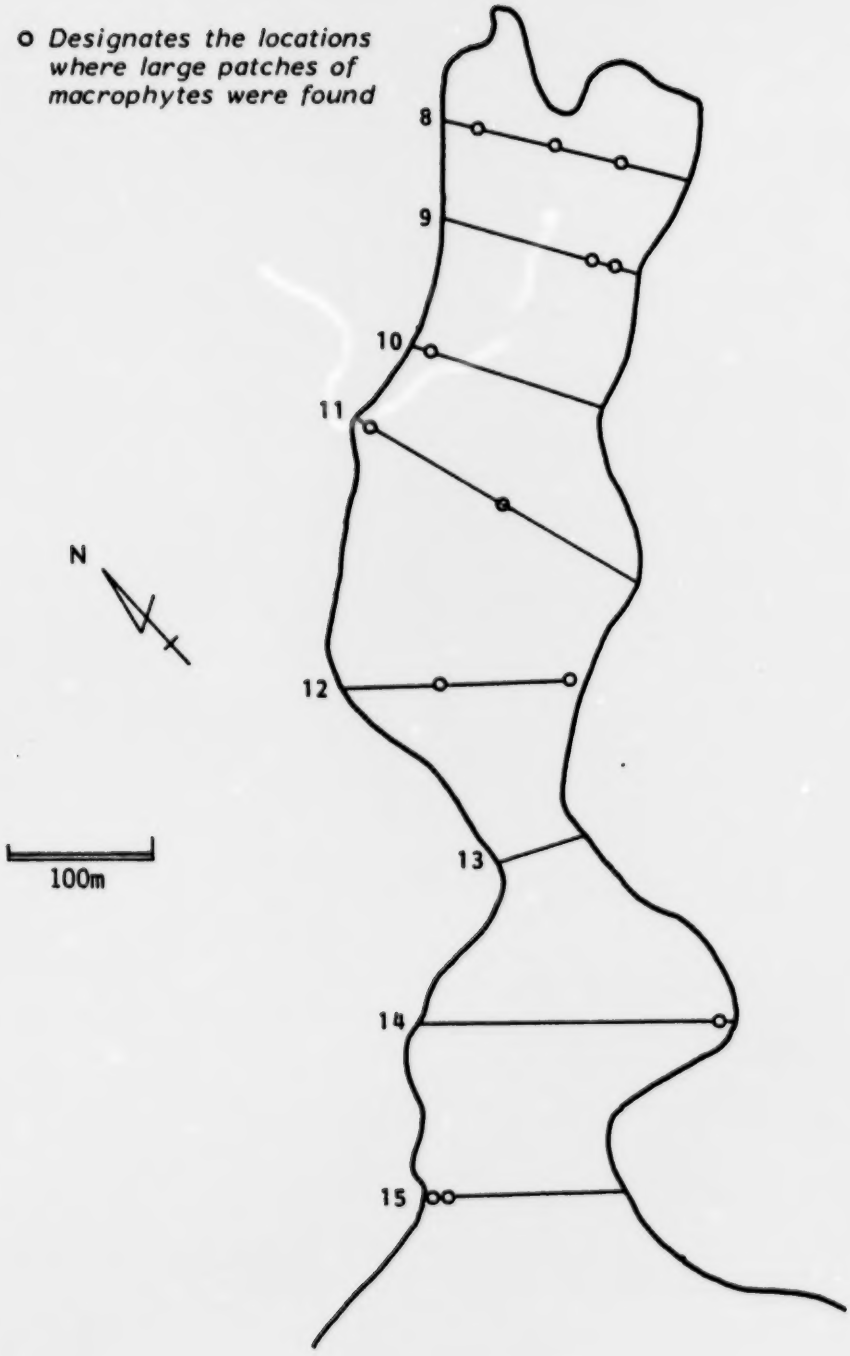


FIGURE 16

DISTRIBUTION OF LARGE PATCHES OF MACROPHYTES IN THE EAST BAY OF ICY LAKE

TABLE 12

MACROPHYTE SPECIES PRESENT ALONG THE TRANSECTS
IN ABIE LAKE - 1983

Transect	1		2		3		4	
Year	1982	1983	1982	1983	1982	1983	1982	1983
Brasenia schreberi	X					X	X	
Chara sp	X			X		X		X
Dulichium arundinaceum			X					
Eleocharis acicularis			X					
Glyceria borealis	X				X	X		
Myriophyllum alterniflorum						X		
M. exalbescens	X		X	X		X		
Najas flexilis	X	X	X			X	X	X
Nymphaea odorata	X	X	X	X	X	X		X
Polygonum natans	X		X	X		X		X
Potamogeton friesii		X		X		X		
P. gramineus		X	X					
P. richardsonii		X				X		
P. robbinsii	X	X		X	X	X	X	X
Ranunculus tricophyllus		X				X		X
Sagittaria sp	X		X	X	X	X		
Sium suave			X					
Typa sp	X	X	X	X	X	X	X	X
Utricularia vulgaris		X	X	X		X		
Vallisneria americana			X	X		X		

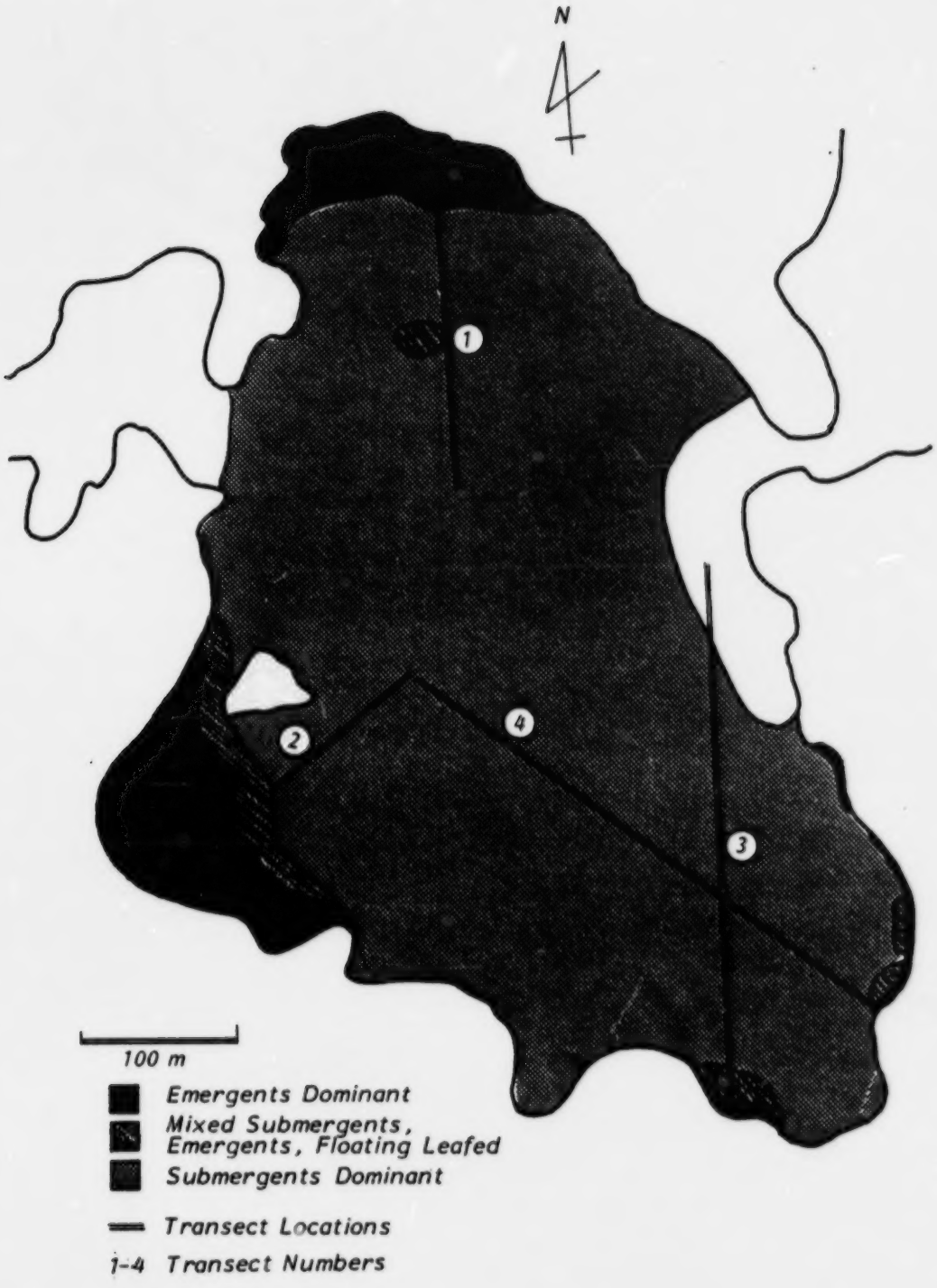


FIGURE 17

MACROPHYTE DISTRIBUTION IN THE EAST BASIN OF ABIE LAKE

an emergent zone dominated by *Typha* spp, a zone consisting of a mixture of submergents, emergents and floating leafed species, and two submergent zones respectively dominated by *Potamogeton robbinsii* and by *Najas flexilis*. These zones generally followed in sequence from shallow to deep water and are described in detail in Ontario Hydro Research Division Report No 84-54-K. The spatial distribution in 1983 was the same, except in two respects. The first is that an additional zone was observed in 1983 at the edge of the mixed zone. The bottom cover in the additional zone was low (15 - 25%) and it can perhaps be considered transitional between the mixed zone and the *Potamogeton robbinsii* zone since it contained some (but not all) of the species present in the former (eg, *Nymphaea odorata, Najas flexilis* and *Ranunculus trichophyllus)* as well as *Potamogeton robbinsii* the dominant of the next zone. The second respect in which the spatial pattern in 1983 differed from 1982 was in the lower total cover in the *Najas* zone and in the increased relative abundance of *Chara* sp. The total cover was reduced from 50 - 100% in 1982 to 1% in 1983 which was largely made up of patches of *Chara*, although *Najas* was still present. Other, uncommon species were similar to those observed in 1982. These included *Ranunculus tricophyllus, Myriophyllum exalbescens, M. alterniflorum* and *Potamogeton richardsonii*. The distribution of the zones along the transects is summarized in Table 13.

Marmion Lake

Near Abie Lake

The species present in the area surveyed on Marmion Lake near Abie Lake are listed in Table 14 and the vegetation is mapped in Figure 18. The species composition and macrophyte distribution in this area were almost identical to those observed in 1982. One emergent community was present which was dominated by *Glyceria borealis* (manna grass). There were three submergent communities which were respectively dominated by *Potamogeton zosteriformis* and *Myriophyllum exalbescens, Potamogeton richardsonii* and *Ranunculus tricophyllus*. The communities are described in detail in Ontario Hydro Research Division Report No 84-54-K and their distribution among the transects is shown in Table 15. The major difference between 1982 and 1983 was along the third transect offshore of the mainland. In 1982 the bottom cover in this area was 100% consisting entirely of *Potamogeton richardsonii*. In 1983 cover had dropped to 50% and although the submergent community was still dominated by *P. richardsonii, P. amplifolius, P. zosteriformis, P. foliosus* and *Myriophyllum exalbescens* were also present.

TABLE 13

POSITIONS OF THE MACROPHYTE ZONES ALONG THE TRANSECTS IN ABIE LAKE (1983)

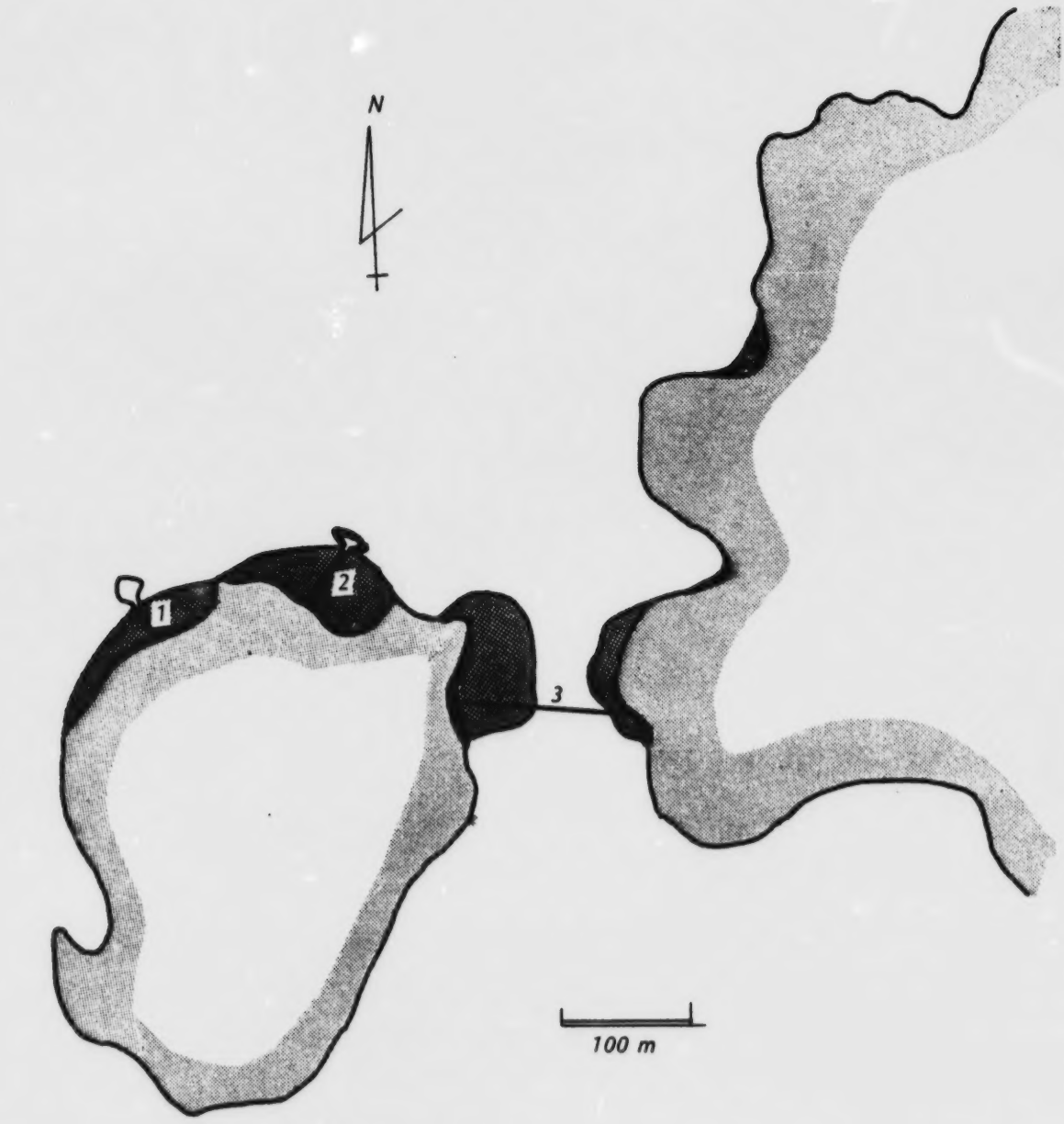
Transect	1	2	3	4
Zone				
Typha (emergent)	1[1]	1	1	1
Mixed	2	2	2	
Transitional	3	3	3	3
Potamogeton robbinsii	4	4	4	2
Najas (Chara) zone	5	5	5	4

[1] The numbers refer to the position of the zone along the transects in the sequence from the shore to the middle of the bay

TABLE 14

MACROPHYTES PRESENT IN MARMION LAKE
NEAR ABIE LAKE

Transect	1		2		3	
Year	1982	1983	1982	1983	1982	1983
Callitriche hermaphroditica	X					
Eloecharis acicularis					X	
Elodea canadensis		X			X	X
Glyceria borealis	X	X	X	X	X	X
Myriophyllum alterniflorum			X	X		
M. exalbescens	X	X	X	X	X	X
Najas flexilis		X	X	X	X	X
Nymphaea odorata		X				
Potamogeton amplifolius	X	X				
P. epihydrus				X		
P. foliosus						X
P. richardsonii	X	X	X	X	X	X
P. spirillus	X	X	X	X		
P. zosteriformis	X	X	X	X	X	X
Ramunculus tricophyllus	X		X	X		
Sagittaria sp		X		X	X	X



Emergent Species Dominant

Submergent Species Dominant

Transect Locations

1-3 Transect Numbers

FIGURE 18

MACROPHYTE DISTRIBUTION IN MARMION LAKE NEAR ABIE LAKE

TABLE 15

DISTRIBUTION OF SUBMERGENT COMMUNITIES AMONG
THE THREE TRANSECTS IN MARMION LAKE NEAR ABIE LAKE

Community[1]/Transect	1	2	3
Potamogeton zosteriformis-Myriophyllum exalbescens	X		X
Potamogeton richardsonii		X	X
Ranunculus tricophyllus		X	

1 Communities are named after the dominant species

Anderson Dam

The species present in the vicinity of Anderson Dam are listed in Table 16 and the vegetation is mapped in Figure 19. At the time of sampling, the water in the vicinity of Anderson Dam was very turbid and the visibility poor (<0.5 m) making it difficult to distinguish the vegetation patterns and to assess species' dominance. The low visibility was likely attributable to heavy storms which occurred earlier in the week. Although the species composition did not change much since 1982 (Table 16) and although the dominant species in 1982 *(Potamogeton zosteriformis, Myriophyllum exalbescens,* and *Ranunculus tricophyllus)* were still common in 1983, some parts of the area had changed substantially. Prominent among these changes were an increase in the abundance of *Potamogeton richardsonii,* which was uncommon in 1982, and the colonization of water deeper than 3.7 m by an unidentified charophyte along transects 2 and 3. The maximum depth at which vegetation was observed in 1983 was 5.0 m in contrast to the 3.5 m depth recorded in 1982.

Four zones were identified on transect 1, three on transect 2 and two along transect 3. The first zone on both transects 1 and 2 was about 10 m long and was devoid of vegetation. The bottom cover for the next 30 m along transect 1 consisted of patches of *Myriophyllum exalbescens, Potamogeton richardsonii* and *Ceratophyllum demersum. M. exalbescens and P. richardsonii* were prominent for the next 10 m and were replaced by *Callitriche hermaphroditica* for the last 10 m of the transect. Cover in the middle two zones was approximately 100%. The second zone on transect 2 was dominated by *Potamogeton richardsonii* mixed with occasional *P. zosteriformis, Najas flexilis* and *Elodea canadensis.* This was replaced by an unidentified charophyte which averaged 50% bottom cover. *Potamogeton zosteriformis* was dominant along the third transect for about the first two-thirds of its length. The unidentified charophyte was dominant on the remainder of the transect where it was mixed with *Ranunculus tricophyllus* and *Callitriche hermaphroditica.* The total cover in these zones was 25 - 30% and 50%, respectively.

The vegetation along the fourth transect did not appear to have changed much since 1982. The total cover was 100% which consisted of a mixture of species which were patchily distributed.

Slush Lake

As in 1982, macrophyte vegetation was sparse in Slush Lake and absent from the area selected for survey. The most common submergent species were distributed in small patches along the shore and included *Nuphar* sp, *Nymphaea odorata, Potamogeton*

TABLE 16

MACROPHYTES PRESENT IN THE VICINITY OF THE ANDERSON DAM, MARMION LAKE

Transect	1		2		3		4	
Year	1982	1983	1982	1983	1982	1983	1982	1983
Callitriche hermaphroditica	X	X			X	X		
Ceratophyllum demersum		X		X	X		X	
Eloecharis acicularis							X	
E. palustris							X	X
Elodea canadensis				X				
Glyceria borealis	X	X						X
Myriophyllum exalbescens	X	X	X	X	X	X	X	X
Najas flexilis	X	X	X	X	X		X	
Potamogeton gramineus								X
P. praelongus						X		
P. richardsonii		X	X	X		X	X	X
P. zosteriformis	X	X	X	X	X	X	X	X
Ranunculus tricophyllus	X	X				X	X	X
Sagittaria sp	X	X			X		X	X
Typha sp							X	X
Unidentified Charophyte					X		X	

FIGURE 19

MACROPHYTE DISTRIBUTION IN MARMION LAKE NEAR THE ANDERSON DAM

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amplifolius, *P. epihydrus* and *Sagittaria* sp (Figure 20). Other submergent species which were locally abundant included *Potamogeton richardsonii*, *P. robbinsii* and *Najas flexilis*. Emergent species were abundant in two small bays along the north shore.

Vegetation Assessment

A summary of the changes occurring in the seven bays surveyed in 1982 and 1983 is presented in Table 17. The largest changes occurred in Snow Lake, in the East Bay of Icy Lake and at the Anderson Dam. The changes in Snow Lake were likely the result of the rise in the water level of the lake and the discharge of sewage into a stream flowing into the lake. The reasons for the changes at the latter two locations are not readily apparent. A road was being constructed at the Dam, but the sampling areas were removed from the area likely to be impacted by the construction activity. A previous disturbance occurred prior to 1981, as a result of draining Moose Lake, but this is similarly unlikely to account for the changes in the vegetation between 1982 and 1983. Stabilization of water levels in Marmion Lake with construction of the West Dam, however, may have influenced the distribution of macrophytes at Anderson Dam. Although no gross disturbances occurred in the east arm of Icy Lake between 1982 and 1983; reduction of the water level in Icy Lake in 1982 may have resulted in substantial winter-kill and the consequent reduction of macrophytes observed in 1983.

3.2.2 Phytoplankton

Phytoplankton samples were taken monthly from May to October, 1983 and in January, 1984, from Snow, Icy, Abie, Slush and Marmion (Marmion South, Marmion North and Anderson Dam) Lakes. The mean seasonal biomass and species composition of the phytoplankton for the seven sampling locations are presented in Table 18 and complete data are presented in Appendix 3. Extremely low phytoplankton biomass estimated for Marmion North in October was inconsistent with the seasonal high primary production value obtained for this location in October and indicated that faulty handling of the sample may have resulted in the loss of part or most of the sample. Therefore October data for Marmion North was not included in calculating mean seasonal biomass.

Mean seasonal biomass indicated that the Baccillariophyta (diatoms) and the Pyrrophyta (flagellates including dinoflagellates and cryptomonads) were the most important algal groups in all the study lakes except Snow Lake where the Cyanophyta (blue-green algae) were of equal importance as the flagellates. The diatoms were the most important group present in Snow, Abie

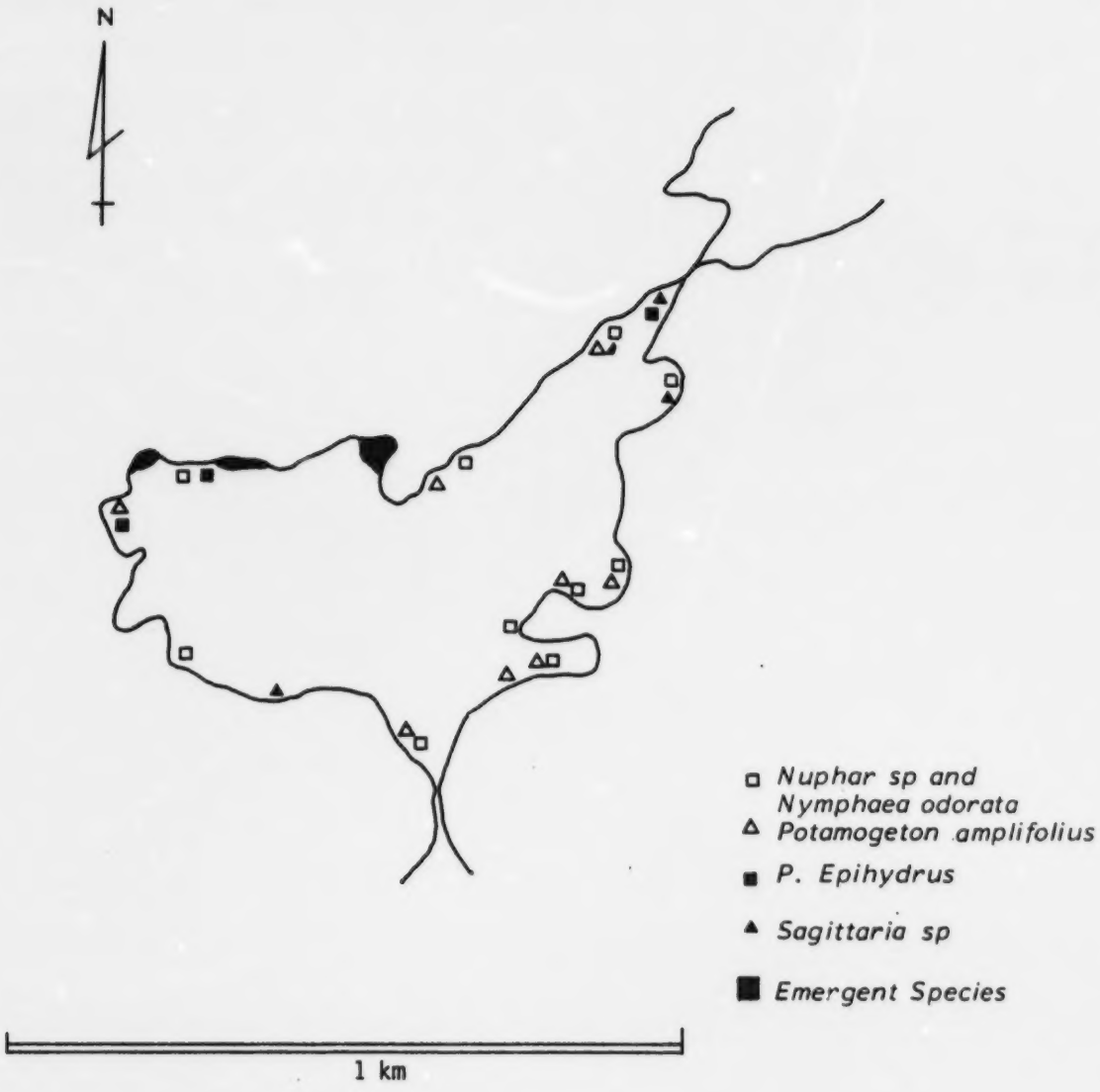


FIGURE 20

DISTRIBUTION OF EMERGENT VEGETATION AND COMMON SUBMERGENT SPECIES IN SLUSH LAKE - 1983

TABLE 17

SUMMARY OF THE CHANGES IN THE MACROPHYTE VEGETATION BETWEEN 1982 AND 1983

Snow Lake	-	expansion of the area occupied by macrophytes in 1983, in particular *Elodea canadensis*, and an increase in the abundance of epiphytic algae
Icy Lake	-	West Bay - an increase in the area occupied by macrophytes in 1983; the species were similar to those occurring in 1982
	-	East Bay - greatly reduced cover in 1983
Abie Lake	-	greatly reduced cover in the center of the bay in 1983 and a decrease in the abundance of *Najas flexilis* in this area
Marmion Lake	-	Near Abie - reduced cover on part of one transect
	-	Anderson Dam - an increase in the maximum depth at which vegetation grew from 3.5 m in 1982 to 5 m in 1983 due to colonization by an unidentified charophyte in water deeper than 3.7 m; an increase in the abundance of *Potamogeton richardsonii*
Slush Lake	-	no significant change

TABLE 18

SPECIES COMPOSITION AND MEAN BIOMASS (mg m^{-3}) OF PHYTOPLANKTON COLLECTED MONTHLY IN THE ATIKOKAN GS STUDY AREA FROM MAY TO OCTOBER, 1983 AND IN JANUARY, 1984

Location	Snow		Icy		Abie		Slush		Harmion					
									South		North*		Anderson Dam	
	mg m^{-3}	%	mg m^{-3}	%	mg m^{-3}	%	mg m^{-3}	%	mg m^{-3}	%	mg m^{-3}	%	mg m^{-3}	%
Cyanophyta	474.1	28.3	65.1	7.7	46.0	3.7	5.9	14.6	124.3	17.5	46.1	9.3	36.9	8.4
Anabaena sp	461.9	27.6	33.4	3.9	19.3	1.5	16.6	2.5	25.4	3.6	20.2	4.1	22.0	5.0
Aphanizomenon flos-aquae	1.4	0.1	23.1	2.7	13.2	1.1	55.2	8.4	47.0	6.6	15.9	3.2	12.6	2.9
Microcystis sp	3.9	0.2	8.6	1.0	10.1	0.8	14.2	2.2	13.3	1.9	6.0	1.2	0.6	0.1
Oscillatoria sp	6.9	0.4	0.0		3.4	0.3	9.9	1.5	38.6	5.4	4.0	0.8	1.7	0.4
Chlorophyta	8.3	0.4	3.4	0.5	6.5	0.5	47.2	7.3	3.9	0.5	4.1	0.8	4.9	1.1
Ankistrodesmus falcatus	0.6	<.1	0.6	< 0.1	0.2	<0.1	1.7	0.3	0.0		0.2	<0.1	0.1	<0.1
Ankistrodesmus mirabilis	0.0		0.0		0.0		0.9	0.1	0.0		0.0		0.0	
Closteriopeis sp	0.0		0.6	0.1	0.0		0.0		1.2	0.2	0.0		0.0	
Cosmarium sp	0.0		0.0		0.0		18.9	2.9	0.0		0.0		0.0	
Crucigenia sp	0.0		0.0		0.4	<0.1	0.4	0.1	1.6	0.2	0.0		0.2	<0.1
Elakatothrix gelatinosa	0.0		0.9	0.1	0.0		1.8	0.3	0.3	<0.1	0.0		0.9	0.2
Golenkinia sp	0.0		0.0		0.0		0.9	0.1	0.0		0.0		0.0	
Kirchneriella sp	0.0		0.0		0.0		0.0		0.0		0.8	0.2	0.0	
Oocystis sp	0.7	<0.1	0.0		3.6	0.3	1.4	0.2	0.7	0.1	2.1	0.4	0.0	
Scenedesmus bijuga	5.6	0.3	1.3	0.2	0.9	0.1	0.2	<0.1	0.1	<0.1	0.2	<0.1	0.3	0.1
Tetrahedron sp	1.4	0.1	0.0		1.4	0.1	8.1	1.2	0.0		0.8	0.2	3.4	0.8
Staurastrum sp	0.0		0.0		0.0		12.9	2.0	0.0		0.0		0.0	
Baccillariophyta	683.0	40.9	237.9	27.4	611.9	48.8	291.9	44.8	381.4	53.6	177.4	25.1	87.0	19.6
Asterionella formosa	0.0		0.0		0.0		0.0		0.7	0.1	0.0		0.0	
Asterionella gracillima	53.9	3.2	20.1	2.3	30.2	2.4	132.6	20.3	21.0	3.0	58.1	0.1	5.0	1.1
Cymbella sp	0.0		0.0		0.0		0.0		0.0		0.8	0.2	0.0	
Diatoma sp	24.6	1.5	2.7	0.3	3.2	0.3	0.0		0.0		0.0		0.8	0.2
Diatoma elongatum	3.5	0.2	6.9	0.8	0.0		0.0		0.0		0.0		0.0	
Fragilaria sp	0.0		0.0		0.0		8.4	1.3	0.0		0.0		0.0	
Fragilaria crotonensis	14.6	0.9	16.7	1.9	15.8	1.3	0.0		1.1	0.2	4.3	0.9	4.1	0.9
Navicula sp	14.3	0.9	1.4	0.2	0.0		0.0		0.0		0.0		0.0	
Synedra sp	207.1	12.4	35.7	4.1	20.7	1.6	90.0	13.8	0.7	0.1	4.2	0.9	3.6	0.8
Tabellaria sp	14.3	0.9	28.6	3.3	17.1	1.4	15.7	2.4	43.6	6.1	44.2	9.0	9.3	2.1
Pennales	44.3	2.6	32.1	3.7	35.0	2.8	2.1	0.3	20.0	2.8	17.5	2.6	10.7	2.4
Meloeira sp	306.2	18.3	83.2	9.6	449.4	35.7	0.0		249.6	35.1	36.9	3.6	39.9	9.0
Rhizosolenia sp	0.0		8.6	1.0	38.6	3.1	42.9	6.6	42.9	6.0	10.0	7.5	12.9	2.9
Stephanodiscus sp	0.2	<0.1	1.9	0.2	1.9	0.2	0.2	<0.1	1.8	0.2	1.4	0.3	0.7	0.2
Chrysophyta	44.0	2.6	42.3	4.9	44.7	3.6	72.7	12.1	18.1	2.5	26.8	5.5	30.6	6.9
Dinobryon sp	39.1	2.3	28.2	3.3	29.9	2.4	67.3	10.3	15.1	2.1	19.5	4.0	13.4	3.0
Dinobryon sociale	4.9	0.3	14.1	1.6	14.8	1.2	5.4	0.8	3.0	0.4	3.9	0.8	17.2	3.9
Mallomonas sp	0.0		0.0		0.0		0.0		0.0		3.4	0.7	0.0	
Pyrrophyta	466.1	27.9	517.3	55.7	549.5	24.7	146.3	22.3	183.5	25.7	236.7	48.3	282.1	53.7
Cryptophyta Type 1	113.1	6.8	146.6	16.9	114.2	9.1	66.8	10.2	84.2	11.8	102.9	21.0	78.9	17.9
Cryptomonas sp	286.6	17.1	316.8	36.6	266.5	21.2	75.4	11.5	67.9	9.5	129.0	26.3	123.2	27.9
Rhodomonas minuta	42.7	2.6	53.9	2.2	45.1	3.6	4.1	0.6	31.4	4.4	4.8	1.0	30.0	6.8
Ceratium sp	0.0		0.0		100.0	7.9	0.0		0.0		0.0		50.0	11.3
Peridinium sp	23.7	1.4	0.0		23.7	1.9	0.0		0.0		0.0		0.0	
Total Biomass	1675.5		866.0		1258.6		654.0		711.2		491.1		441.5	

* October data missing

and Slush Lakes and at Marmion South while the flagellates were the main algae present in Icy Lake and at Marmion North and Anderson Dam.

The diatoms and flagellates were also the two main groups present in the study area in 1981 and 1982 (Ontario Hydro Research Division Report Nos 83-338-K and 84-54-K) and the blue-greens were also found to be prominent in Snow Lake in 1982.

Mid-summer samples from the Experimental Lakes Area (Schindler and Holmgren 1971) indicated that the phytoplankton in these lakes were dominated by the Chrysophyta (golden algae). The diatoms were only found to be important in some of the ELA lakes studied by Schindler and Holmgren (1971) while the flagellates were an important part of the algal biomass in all their study lakes. In our study lakes the chrysophytes made up relatively small portions of the mean seasonal algal biomass while the diatoms constituted a major portion of the algal biomass. The similarity in the importance of the flagellates and the differences in the proportions of the diatom and chrysophyte biomass in the ELA lakes and our study lakes were also noted in the 1982 report (Ontario Hydro Research Division Report No 84-54-K). The ELA lakes and our study lakes also differed in water chemistry with the former having lower levels of nutrients and cations (see Section 3.1.4).

The total number of taxa identified during the sampling season ranged from 23 at Icy Lake and Marmion South to 26 at Slush Lake. The flagellate *Cryptomonas* sp was relatively abundant at all sampling locations. The blue-green alga *Anabaena* and the diatom *Asterionella gracillima* were common and widespread, while *Melosira* sp was common in all lakes except Slush. Other taxa that were common and widespread were the blue-green algae *Aphanizomenon flos-aquae* and common diatoms were *Fragilaria crotonensis* (present at all locations except Slush Lake), *Synedra* sp, *Tabellaria* sp, *Rhizosolenia* sp (present at all locations except Snow Lake), and a group of unidentified pennales. The diatom *Stephanodiscus* sp was found in low densities at all locations. The chrysophyte *Dinobryon* was also widespread and an unidentified flagellate (cryptophyte) was found to be relatively abundant at all locations.

Mean total biomass ranged from 441.5 mg/m^3 at Anderson Dam to 1675.7 mg/m^3 in Snow Lake. Mean seasonal biomass estimated for Snow, Icy, and Abie Lakes were higher than those estimated for Slush Lake and the Marmion Lake locations. This is consistent with the mean and maximum phytoplankton primary production levels which were higher for Snow, Icy, and Abie Lakes than for Slush and Marmion Lakes. The levels of most of the water

chemistry parameters monitored were also found to be higher in Snow, Icy and Abie Lakes than in Slush and Marmion Lakes.

No seasonal trends consistent among the study basins were observed in the biomass of the phytoplankton groups.

Phytoplankton biomass (Figures 21 - 24) was highest in October in Snow (3188 mg/m^3), Icy (1602 mg/m^3) and Abie (4220 mg/m^3) Lakes and at Marmion South (1854 mg/m^3). In Slush Lake phytoplankton biomass was highest in May (1685 mg/m^3) and at Anderson Dam it was highest in August (862 mg/m^3). In the months when maximum total biomass was estimated the diatoms dominated the phytoplankton in Snow, Abie and Slush Lakes and at Marmion South while the flagellates dominated in Icy Lake and at Anderson Dam. The prominence of diatoms in May in Slush Lake indicates that the seasonal high in phytoplankton density found at this time may have been part of the spring diatom increase. At Marmion North, for which October data is missing, highest biomass was estimated for September (834 mg/m^3). The flagellates were the dominant group present at this location at this time. Primary production levels were generally highest in October at all locations except Icy Lake where highest biomass was found in September.

The flagellates or the diatoms were the main group present on each sampling date in all lakes except Snow Lake where the blue-green algae dominated in July and September. The blue-green algae dominance in Snow Lake in July and September were due to relatively high densities of *Anabaena* (145 and 1871 mg/m^3).

The main taxa present in the lakes on the various sampling dates are presented in Table 19. *Melosira* was dominant or co-dominant in the spring and/or fall in all lakes except Slush Lake. *Cryptomonas* and an unidentified cryptophyte taxon were prominent on most sampling occasions in all lakes except Snow Lake which differed most in terms of species composition. In Snow Lake *Anabaena* was prominent in June, July and September and *Synedra* dominated in May and August. Other exceptions to the dominance by *Melosira*, *Cryptomonas* and the unidentified cryptophyte was the dominance by *Ceratium* in June and August in Abie Lake and in August at Anderson Dam, co-dominance of *Dinobryon* and *Asterionella gracillima* in May and dominance of *A. gracillima* in June in Slush Lake. In addition there was the dominance of *Tabellaria* in January at Marmion South and North, and the dominance of *Rhodomonas minuta* in June at Anderson Dam.

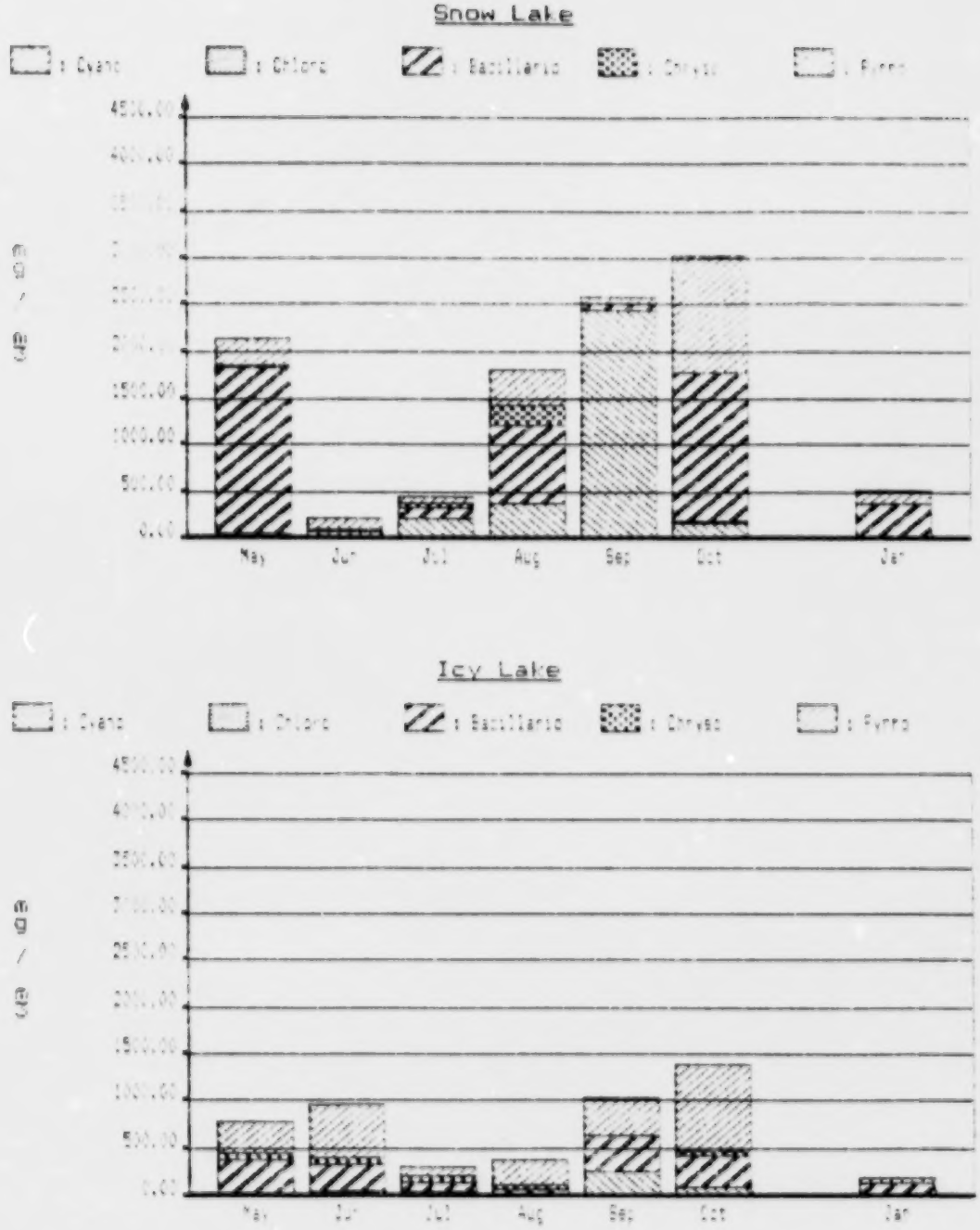
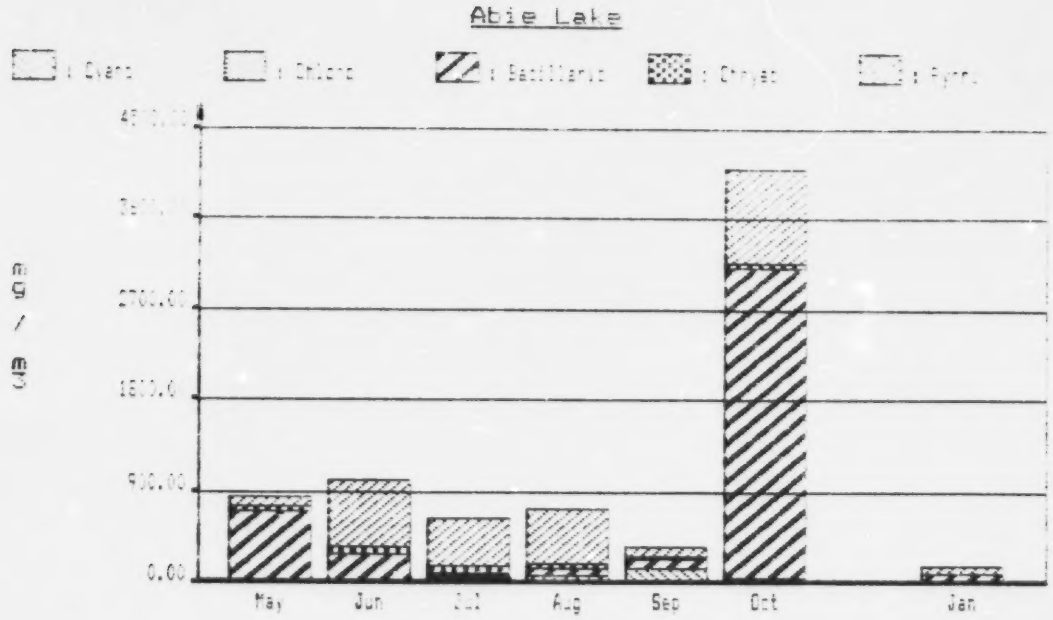


FIGURE 2.
MONTHLY DISTRIBUTION OF PHYTOPLANKTON GROUPS IN
SNOW AND ICY LAKES, 1985



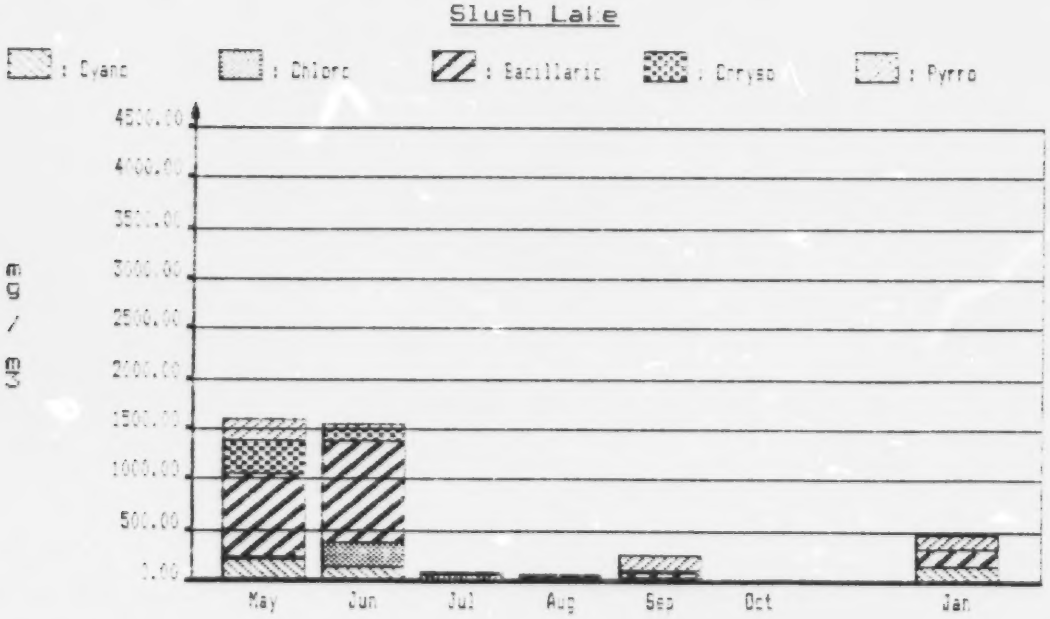
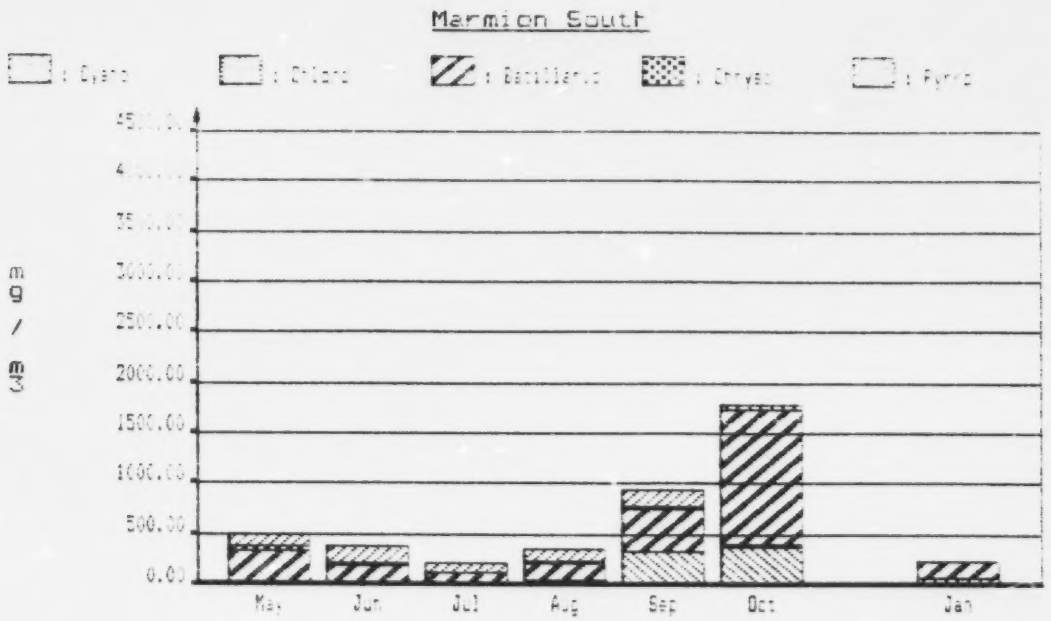


FIGURE 22
MONTHLY DISTRIBUTION OF PHYTOPLANKTON GROUPS IN ABIE AND SLUSH LAKES, 1985



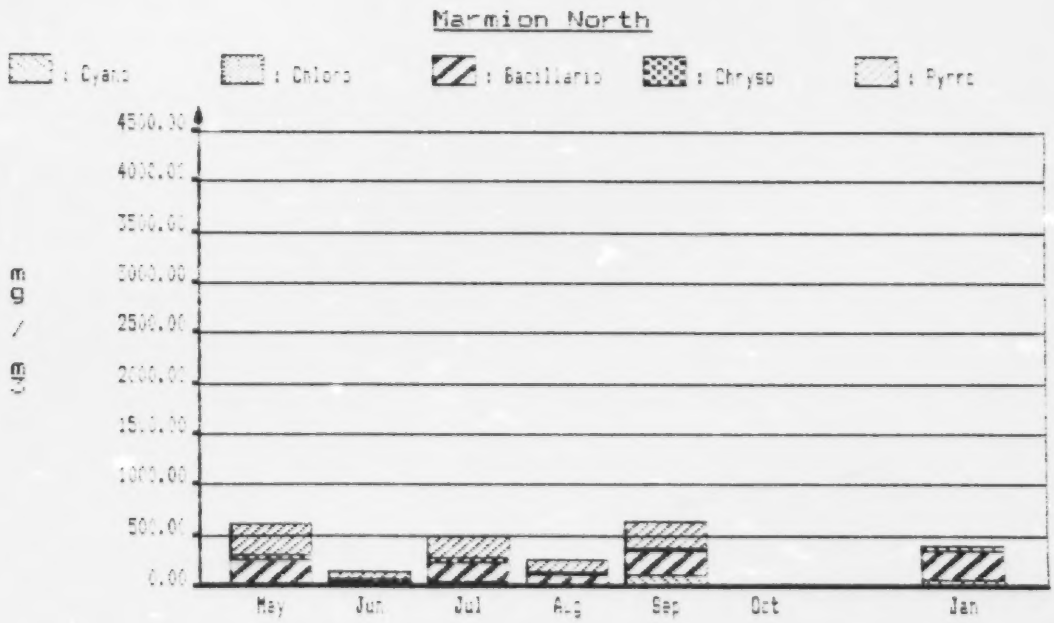


FIGURE 27
MONTHLY DISTRIBUTION OF PHYTOPLANKTON GROUPS AT MARMION SOUTH AND MARMION NORTH, 1980

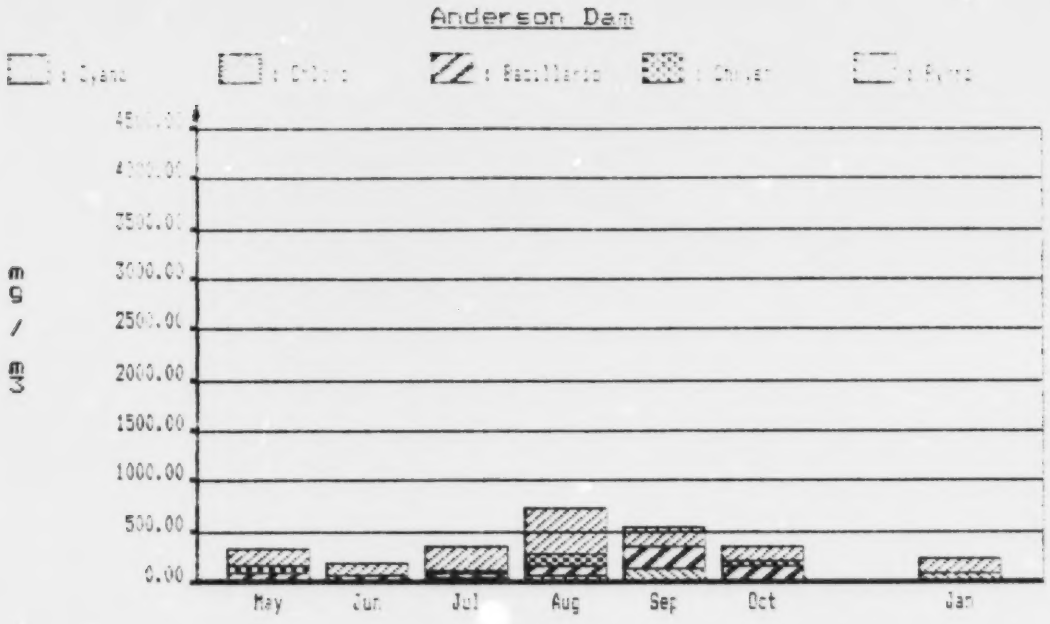


FIGURE 24
MONTHLY DISTRIBUTION OF PHYTOPLANCTON GROUPS IN
ANDERSON DAM, 1980

Table 19

MAIN PHYTOPLANKTON TAXA PRESENT AT VARIOUS LOCATIONS ON EACH SAMPLING DATE - ATIKOKAN PREOPERATIONAL STUDY YEAR III, 1983

Location	1983						1984
	May 17	June 17	July 15	August 06	September 21	October 27	January 19
Snow Lake	*Synedra* (25%) *Melosira* (21%)	*Dinobryon sociale* (40%) *Rhalomonas minuta* (30%) *Anabaena* (21%)	*Anabaena* (35%)	*Synedra* (42%)	*Anabaena* (92%)	*Melosira* (50%) *Cryptomonas* (36%)	*Cryptomonas* (24)
Icy Lake	*Synedra* (31%) *Cryptomonas* (31%)	*Cryptomonas* (45%)	*Cryptophyte*[1] (53%)	*Cryptomonas* (61%)	*Cryptomonas* (28%) *Melosira* (28%)	*Cryptomonas* (48%)	*Cryptophyte*[1] (32%)
Able Lake	*Melosira* (48%)	*Ceratium* (32%) *Cryptomonas* (23%)	*Cryptomonas* (41%)	*Ceratium* (40%)	*Cryptophyte*[1] (23%) *Anabaena* (21%)	*Melosira* (62%)	*Cyrptomonas* (31%) *Cryptophyte*[1] (25%)
Slush Lake	*Dinobryon* (19%) *Asterionella gracillima* (19%) *Rhizosolenia* (18%)	*Asterionella gracillima* (32%) *Synedra* (23%)	*Cryptophyte*[1] (45%)	*Cryptophyte*[1] (45%)	*Cryptomonas* (47%)	*Cryptophyte*[1] (40%)	*Cryptomonas* (25%)
Marmion South	*Melosira* (45%)	*Cryptophyte*[1] (25%) *Cryptomonas* (22%)	*Cryptophyte*[1] (21%) *Rhalomonas minuta* (21%)	*Cryptophyte*[1] (28%) *Cryptomonas* (21%)	*Melosira* (34%)	*Melosira* (59%)	*Tabellaria* (55%)
Marmion North	*Cryptomonas* (42%) *Melosira* (28%)	*Cryptophyte*[1] (37%)	*Cryptomonas* (29%) *Cryptophyte*[1] (22%)	*Cryptophyte*[1] (32%) *Cryptomonas* (29%)	*Cryptophyte*[1] (24%) *Cryptomonas* (21%)	-	*Tabellaria* (48%)
Anderson Dam	*Cryptomonas* (33%)	*Rhalomonas minuta* (34%) *Cryptophyte*[1] (28%)	*Cryptomonas* (63%)	*Ceratium* (41%) *Cryptophyte*[1] (21%)	*Melosira* (31%) *Cryptomonas* (26%) *Anabaena* (21%)	*Cryptomonas* (35%) *Melosira* (27%)	*Cryptomonas* (45%) *Cryptophyte*[1] (25%)

[1] unidentified Cryptophyte taxon

TABLE 20

TROPHIC CLASSIFICATION OF ATIKOKAN LAKES
BASED ON PHYTOPLANKTON PRIMARY PRODUCTION

Trophic Status	Primary Production ($mg/m^3/h$)		Location
	Mean	Maximum	
Oligotrophic	<5	<15	Slush
Transition	>5	<15	Marmion North Anderson Dam Marmion South
Secondary Eutrophic	>10	>15	Icy Abie Snow

Primary Production

Primary production values ranged from a low of 1.7 mg $C/m^3/h$, recorded at Anderson Dam on January 20, 1984, to a high of 42.8 mg $C/m^3/h$ at Snow Lake on September 22, 1983 (Table 21). The high production value for Snow Lake corresponded with a notable bloom of the filamentous blue-green, *Anabaena* sp. Phytoplankton biomass on this date was approximately two times higher in Snow Lake than at other locations and *Anabaena* contributed to 92% of the total biomass. Primary production was generally highest during September and October at all locations, corresponding with fall turnover of the lakes. On September 22, the initial stages of turnover were evident with epilimnetic temperatures of 13 to 15°C and thermoclines which occurred at depths greater than 7 m at all locations (Figures 10 - 12). By October 27 all lakes with the exception of the deepest portion of Slush Lake had become isothermal with temperatures ranging between 6 and 8°C.

Primary production levels were relatively low at sites sampled during the May to August period. It is possible, however, that the monthly sampling schedule missed the spring diatom pulse characteristic of northern shield lakes.

A ranking of the sites in terms of trophic status, based on mean and maximum levels of primary production measured for the seven sampling dates is given in Table 20. Classification of the lakes follows Vollenweider *et al* (1974), who considered

TABLE 21

MULTIPLE RANGE COMPARISON OF PHYTOPLANKTON PRIMARY PRODUCTION AT SEVEN LOCATIONS, ATIKOKAN, 1983-84

Date	Site and Mean Production ($mgC/m^3/h$)							$f_{(6,14)}$*
1983								
May 17	SLU	IC	MS	SL	MN	AD	AB	
	2.9	4.6	5.6	5.7	6.1	6.4	7.2	NS
June 16	SLU	AD	MN	MS	IC	AB	SL	
	2.5	4.4	4.7	6.1	7.9	10.3	11.3	12.07
July 15	SLU	MS	AD	MN	SL	IC	AB	
	3.6	5.2	5.2	7.3	10.3	11.2	12.6	12.94
Aug 6	MN	AD	SLU	IC	MS	AB	SL	
	2.3	2.6	2.7	5.0	6.1	6.1	8.6	51.40
Sept 22	MN	SLU	AD	MS	IC	AB	SL	
	2.7	4.0	8.5	11.2	14.4	15.6	42.8	288.4
Oct 27	SLU	AD	MN	MS	AB	SL	IC	
	9.7	11.1	13.1	13.7	17.8	19.8	21.0	10.32
1984								
Jan 20	AD	MN	AB	SLU	IC	MS	SL	
	1.7	2.0	5.5	7.2	7.6	7.6	8.5	14.24

* 1 way ANOVA; Critical f = 2.85

transition lakes to be intermediate in status between oligotrophy and mesotrophy, and secondary eutrophic lakes to be those with relatively high annual primary production and the occurrence of occasional algal blooms. Analysis of variance and multiple range testing of means was used to compare primary production levels between lakes on individual dates (Table 21). These data are largely supportive of the trophic status and ranking ascribed to the lakes (Table 20).

3.2.3 Zooplankton

Zooplankton were collected monthly from May through October, 1983 at Snow, Icy, Abie, Slush and Marmion (Marmion South, Marmion North and Anderson Dam) Lakes. Complete data are presented in Appendix 4.

Rotifers

The species composition of the rotifers in the study lakes were quite similar. *Keratella cochlearis*, *Polyarthra* spp and *Kellicottia longispina* were the most abundant rotifers present in all of the study lakes. The mean densities (Table 22) indicate that *K. cochlearis* was the most abundant species present in all of the lakes. *Polyarthra* was the second most prevalent taxa present in all lakes except Icy where *K. longispina* was more abundant. *Gastropus* spp, *Asplanchna* spp and *Keratella quadrata* were some of the more common rotifers in the study area.

Keratella cochlearis, *Polyarthra* spp and *Kellicottia longispina* were also the main rotifers found in the study area in 1981 and 1982 (Ontario Hydro Research Division Report Nos 83-338-K and 84-54-K). These three taxa have been described as dominant forms in oligotrophic lakes of the temperate zone while *Asplanchna* and *Gastropus* were among those described as common in oligotrophic lakes (Pejler 1962, 1965 and Ruttner-Kolisko 1974).

The total number of taxa identified over the sampling season ranged from 17 at Icy and Abie Lakes to 20 at the three Marmion Lake locations.

Higher numbers of rotifers were found in Snow, Icy and Abie Lakes than in Slush Lake and at the Marmion Lake locations. The mean seasonal numbers of rotifers were estimated to be 272 177, 283 547 and 121 441 m^{-3} for Snow, Icy and Abie Lakes, respectively, and 65 313, 57 227, 58 641 and 98 436 m^{-3} for Slush Lake, Marmion South, Marmion North and Anderson Dam. This spatial distribution of rotifers is consistent with those of the water chemistry parameters, phytoplankton and primary production of the lakes which were all found in higher levels in Snow, Icy and Abie Lakes than in Slush and Marmion Lakes.

Table 22

SPECIES COMPOSITION AND MEAN DENSITIES (No m^{-3}) OF ROTIFERS IN LAKES INCLUDED IN THE ATIKOKAN CS PREOPERATIONAL STUDY - YEAR III, 1983

Taxa	Seav		Icy		Abie		Blush		Moraine					
									South		North[a]		Anderson Bay	
	No m^{-3}	%	No m^{-3}	%	No m^{-3}	%	No m^{-3}	%	No m^{-3}	%	No m^{-3}	%	No m^{-3}	%
Brachionus spp													37.5	<0.1
Keratella cochlearis	108 210.0	39.8	102 448.0	36.1	51 612.5	42.5	35 076.7	53.7	27 189.8	47.5	29 585.5	50.5	43 393.5	44.3
Keratella quadrata	4 500.0	1.7	7 763.5	2.7	4 085.8	3.4	2 546.2	3.9	720.8	1.3	603.5	1.0	1 370.8	1.4
Keratella taurella	525.0	0.2	1 193.3	0.4	345.2	0.3	584.3	0.9	23.2	<0.1	34.7	0.1		
Kotholca spp	37.5	<0.1							23.2	<0.1			18.8	<0.1
Kotholca squamula			75.0	<0.1			105.8	0.2			11.5	<0.1	37.5	<0.1
Kellicottia longispina	17 775.0	6.5	16 581.3	5.8	16 571.3	13.6	3 359.8	5.1	5 689.7	9.9	4 592.3	7.8	16 174.5	16.4
Lepadella spp									26.5	<0.1				
Lepadella patella											26.5	<0.1		
Lecane spp	150.0	0.1			61.7	0.1			52.8	0.1			18.8	<0.1
Trichocerca spp	112.5	<0.1					26.5	<0.1	125.7	0.2	49.7	0.1	487.5	0.5
Trichocerca cylindrica	7 725.0	2.8	2 061.0	0.7	1 050.0	0.9	366.0	0.6	1 375.3	2.4	969.7	1.7	1 275.5	1.3
Trichocerca multicrinis	1 987.5	0.7	758.5	0.3	1 067.5	0.9	370.7	0.6	767.2	1.3	730.8	1.2	1 217.7	1.2
Trichocerca porcellus							8.8	<0.1			105.8	0.2	61.7	0.1
Trichocerca longiseta	37.5	<0.1			150.0	0.1			105.8	0.2				
Asplanchna spp	12 675.0	4.7	19 511.3	6.9	6 018.3	5.0	3 306.8	5.1	2 768.2	4.8	2 064.8	3.5	3 900.7	4.0
Polyarthra spp	73 950.0	27.2	47 712.5	16.8	17 633.0	14.5	11 655.2	17.8	9 754.0	17.0	12 307.7	20.8	17 951.0	18.2
Synchaeta spp	6 637.5	2.4	3 703.7	1.3	3 949.7	3.3	1 422.3	2.2	747.3	1.3	755.5	1.3	786.8	0.8
Ploesoma spp	75.0	<0.1	153.3	0.1			8.8	<0.1	132.3	0.2	48.7	0.1		
Ploesoma truncatum	1 050.0	0.4	8 935.8	3.2	2 025.0	1.7	240.3	0.4	714.2	1.2	529.0	0.9	502.7	0.5
Filinia longiseta	2 850.0	1.0	12 477.5	4.4	1 412.7	1.2	1 825.7	2.8	475.0	0.8	156.8	0.3	274.3	0.3
Conochilus unicornis	2 041.7	0.8	4 087.5	1.4	2 106.2	1.7	800.5	1.2	555.5	1.0	1 045.0	1.8	673.3	0.7
Gastropus spp	16 200.0	6.0	48 974.8	17.3	11 104.7	9.1	2 601.5	4.0	4 982.7	8.7	4 092.7	7.0	8 681.2	8.8
Notholca sp.	7 687.5	2.8	2 095.2	0.7			79.3	0.1			26.5	0.0	37.5	<0.1
Unidentified rotifers	7 950.0	2.9	5 014.8	1.8	2 247.7	1.9	928.3	1.4	998.7	1.7	1 003.5	1.7	1 336.7	1.3
Mean Total	272 177.0		283 547.0		121 441.0		65 313.3		57 227.8		58 641.2		98 436.0	

Keratella cochlearis was the dominant rotifer taxa present in the study lakes in May and October and on most of the remaining sampling dates (Table 23). The exceptions were *Polyarthra's* dominance in August and September in Snow and Icy Lakes and in August in Slush Lake and at Marmion South and North and *Kellicottia longispina's* dominance in June in Snow Lake and at Anderson Dam, in July at Marmion North and in September at Marmion South.

The relative abundance of *Keratella cochlearis* was generally higher in October than in the remaining months in most of the lakes. In the samples in which it was the most abundant taxa it made up from 25 (Slush Lake in September) to 75% (Snow Lake in May and October, and Icy and Abie Lakes in October) of the total number of rotifers. In the samples in which they were numerically dominant the relative abundance of *Polyarthra* ranged from 22 (Slush Lake in August) to 53% (Snow Lake in September) and that of *Kellicottia longispina* ranged from 40 (Marmion South in September and Marmion North in July) to 52% (Anderson Dam in June).

No consistent trends were observed in the seasonal density distributions of the main rotifers at the various sampling locations (Figures 25 to 28). In most lakes the densities of *Keratella cochlearis* was higher in May/June and September/October with lowest densities generally found in July or August. Highest peak density of this species was estimated for Snow Lake in May (321 075 m^{-3}). In Abie and Slush Lakes *Polyarthra* was found in highest numbers in May while at the remaining locations it was found in higher numbers in August or September. Highest peak density of *Polyarthra* was estimated for Snow Lake in September (252 000 m^{-3}). Occurrence of peak densities of *Gastropus* spp at the various sampling locations was relatively inconsistent. Maximum seasonal densities of *Asplanchna* spp occurred in May at all locations except Marmion South and North where it occurred in August and June, respectively. Highest peak densities of *Gastropus* spp and *Asplanchna* spp were found in Icy Lake in June (182 250 and 49 950 m^{-3}, respectively).

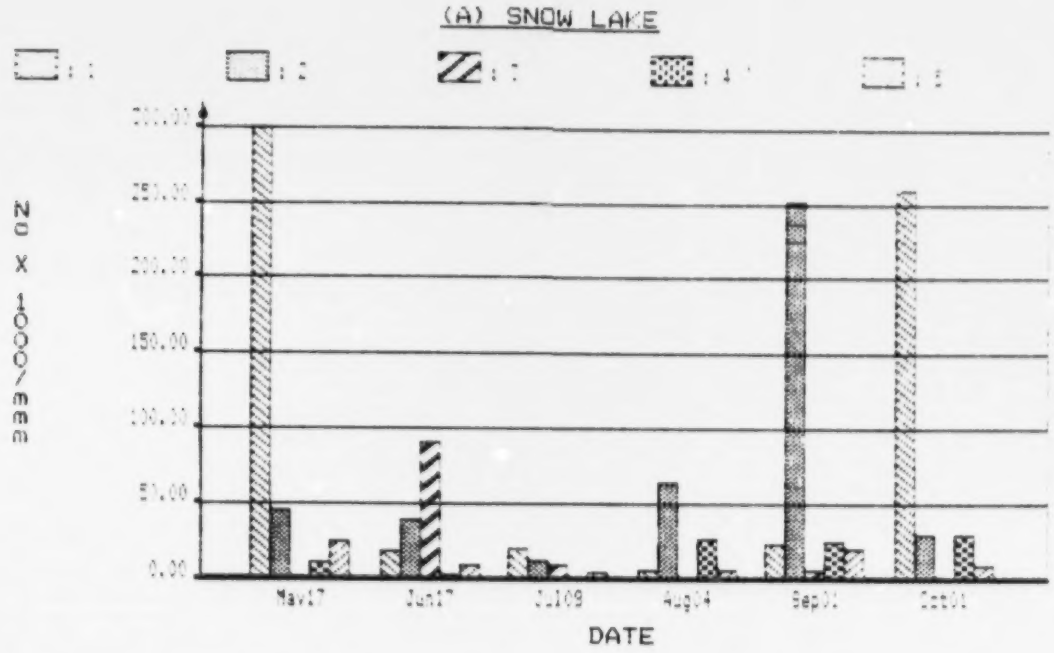
Crustacean Zooplankton

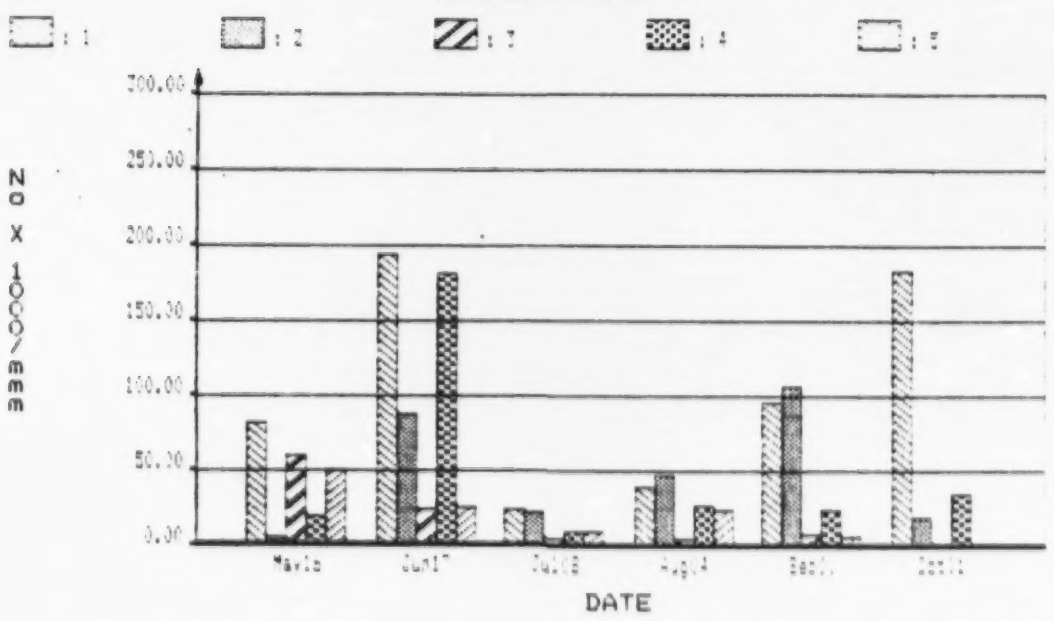
The cyclopoid copepods were the most abundant crustacean zooplankton in all the study lakes except Snow Lake where the cladocerans were more prominent (Table 24). The cyclopoid copepods made up from 37 (Snow Lake) to 53% (Abie Lake) of the mean seasonal total numbers of crustacean zooplankton estimated for the lakes. The most abundant adult cyclopoid copepod form present, and therefore most abundant cyclopoid copepod taxon present, was *Diacyclops bicuspidatus thomasi*. The only other

Table 23

MAIN BUTIFERS TAXA PRESENT AT VARIOUS LOCATIONS ON EACH SAMPLING DATE
- ATIKOKAN PREOPERTIONAL STUDY YEAR II, 1983

	May 17	June 17	July 15	August 16	September 4	October 27
Snow Lake	Keratella cochlearis (75%) Polyarthra (11%)	Keratella cochlearis (49%) Polyarthra (21%)	Keratella cochlearis (37%) Polyarthra (24%)	Polyarthra (44%) Gastropus (19%)	Polyarthra (53%) Hexarthramira (10%)	Keratella cochlearis (75%) Polyarthra (9%) Gastropus (9%)
Icy Lake	Keratella cochlearis (34%) Kellicottia longispina (25%)	Keratella cochlearis (35%) Gastropus (33%)	Keratella cochlearis (30%) Polyarthra (27%)	Polyarthra (28%) Keratella cochlearis (23%)	Polyarthra (27%) Keratella cochlearis (24%)	Keratella cochlearis (75%) Gastropus (14%)
Able Lake	Keratella cochlearis (37%) Kellicottia longispina (25%)	Keratella cochlearis (34%) Polyarthra (24%)	Keratella cochlearis (53%) Kellicottia longispina (18%)	Keratella cochlearis (29%) Synchaeta (17%)	Keratella cochlearis (47%) Polyarthra (15%)	Keratella cochlearis (75%) Gastropus (18%)
Slush Lake	Keratella cochlearis (71%) Polyarthra (13%)	Keratella cochlearis (38%) Polyarthra (27%)	Keratella cochlearis (58% Polyarthra (14%)	Polyarthra (22%) Keratella cochlearis (12%)	Keratella cochlearis (25%) Polyarthra (24%)	Keratella cochlearis (61%) Gastropus (8%)
Marmion South	Keratella cochlearis (48%) Polyarthra (16%)	Keratella cochlearis (53%) Kellicottia longispina (18%)	Keratella cochlearis (51%) Kellicottia longispina (32%)	Polyarthra (34%) Keratella cochlearis (23%)	Kellicottia longispina (42%) Polyarthra (21%)	Keratella cochlearis (73%) Gastropus (10%)
Marmion North	Keratella cochlearis (34%) Asplanchna (15%)	Keratella cochlearis (67%) Polyarthra (21%)	Kellicottia longispina (40%) Keratella cochlearis (39%)	Polyarthra (38%) Keratella cochlearis (26%)	Keratella cochlearis (48%) Polyarthra (23%)	Keratella cochlearis (64%) Gastropus (15%)
Anderson Dam	Keratella cochlearis (33%) Kellicottia longispina (30%)	Kellicottia longispina (52%) Keratella cochlearis (92%)	Keratella cochlearis (33%) Kellicottia longispina (31%)	Keratella cochlearis (50%) Polyarthra (24%)	Keratella cochlearis (39%) Polyarthra (28%)	Keratella cochlearis (61%) Polyarthra (16%)





1 Keratella cochlearis
2 Polyarthra spp
3 Kellicottia longispina
4 Gastropus spp
5 Asplanchna spp

FIGURE 25

SEASONAL DENSITIES (NO m-3) OF MAIN ROTIFERS FOUND IN (A) SNOW AND (B) ICY LAKES, ATIKOKAN GS PREOPERATIONAL STUDY, 1983.

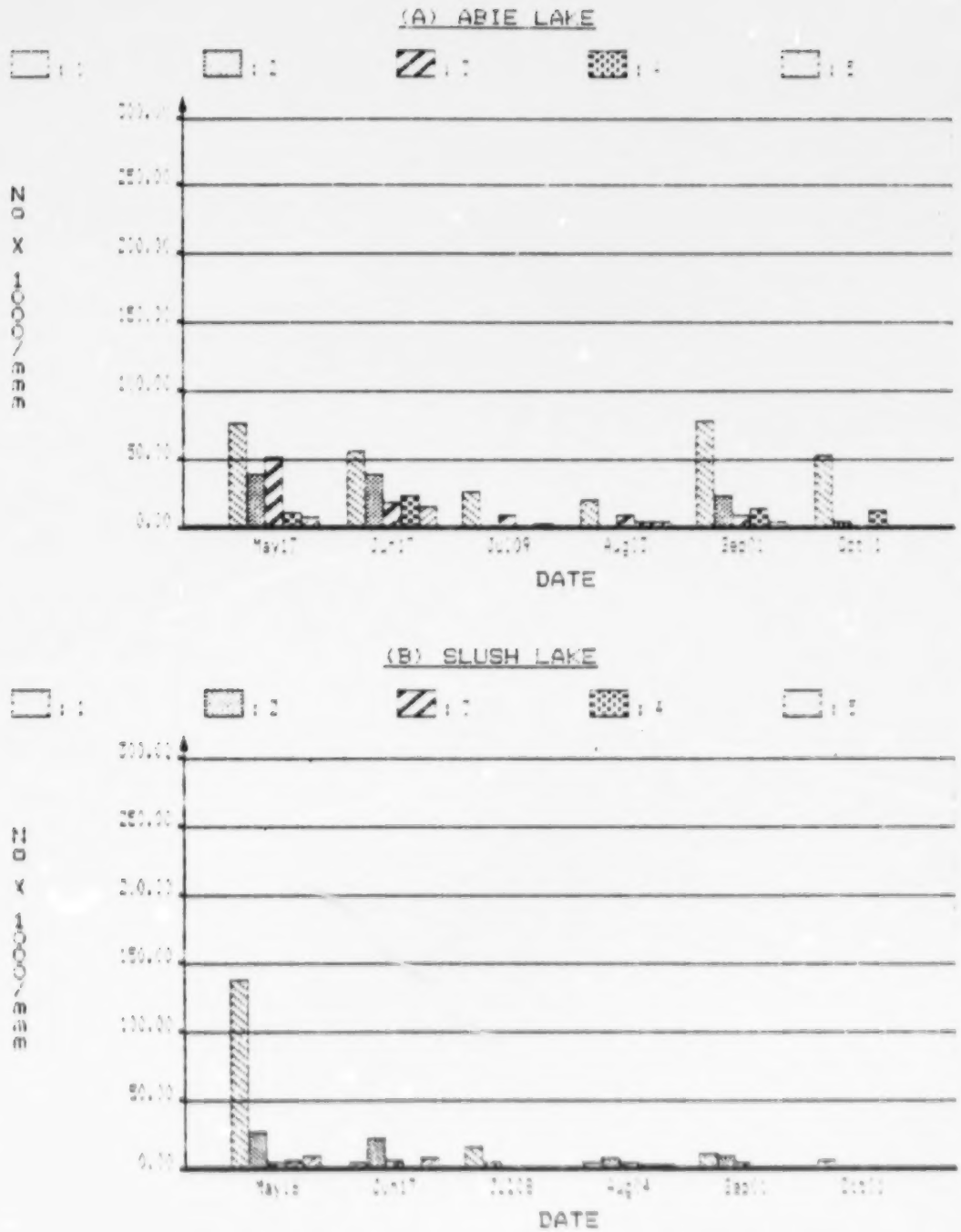
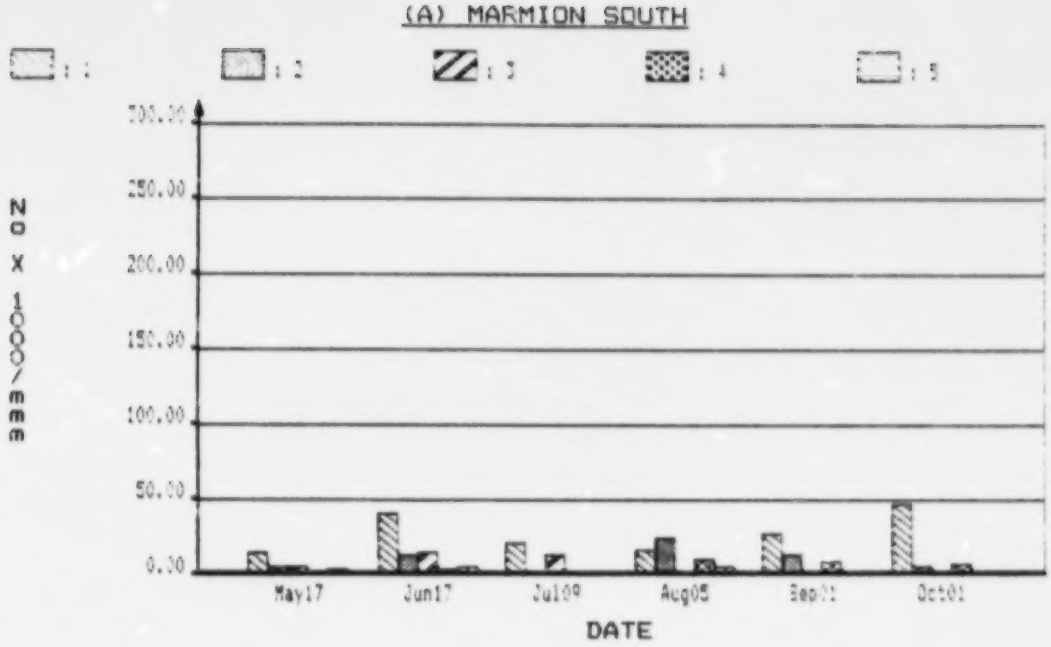
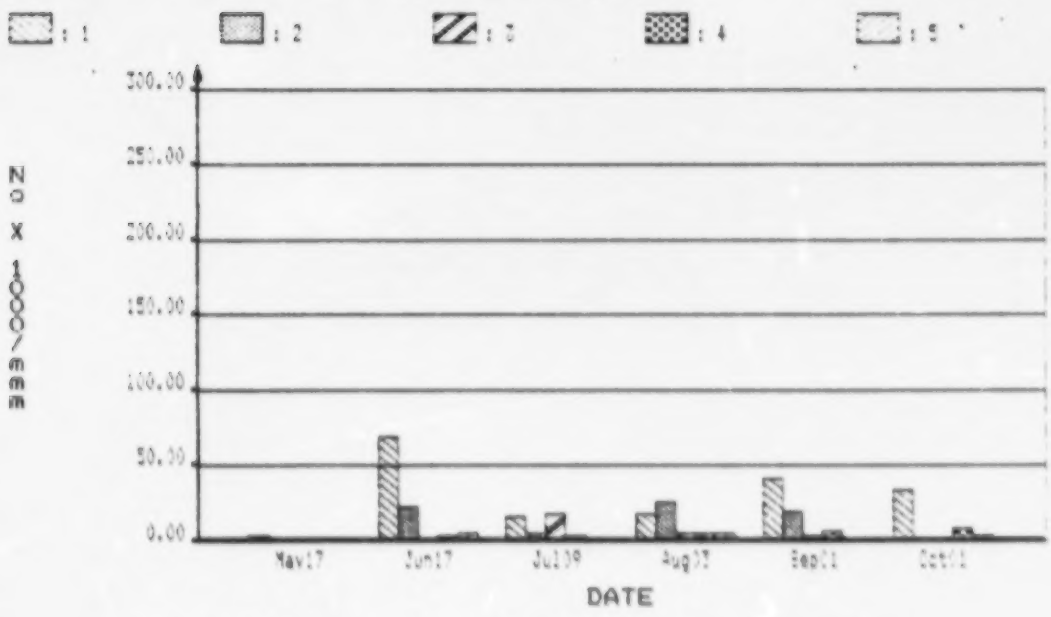


FIGURE 26

SEASONAL DENSITIES (NO m-3) OF MAIN ROTIFERS IN (A) ABIE AND (B) SLUSH LAKES, ATIKOKAN GS PREOPERATIONAL STUDY, 1981.

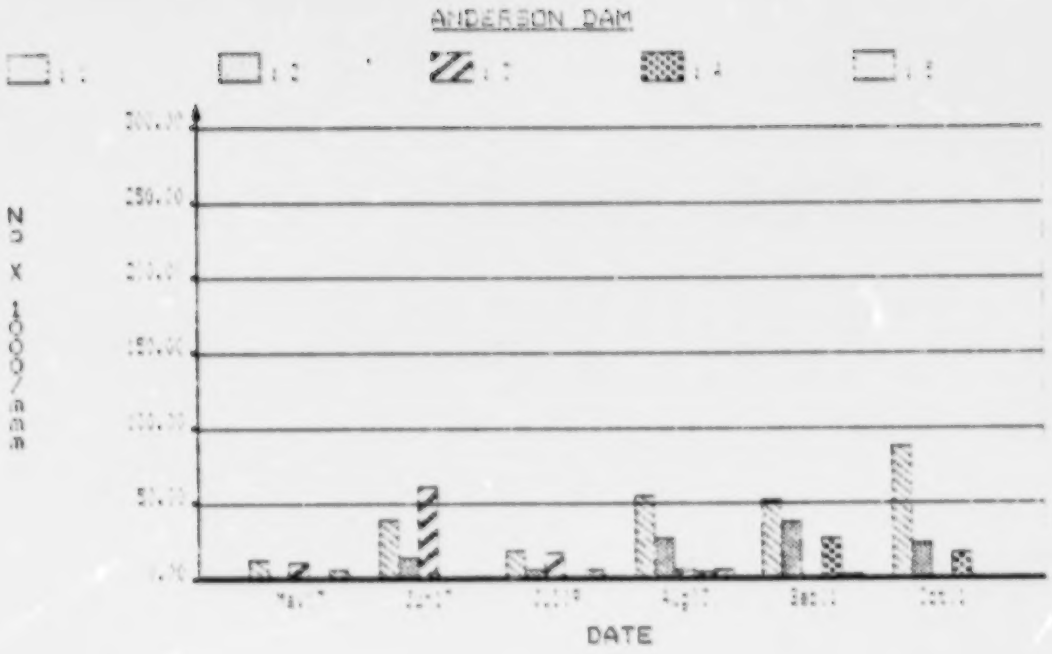




1 Keratella cochlearis
2 Polyarthra spp
3 Kellicottia longispina
4 Gastropus spp
5 Asplanchna spp

FIGURE 27

SEASONAL DENSITIES (NO /m-3) OF MAIN ROTIFERS FOUND AT (A) MARMION SOUTH MARMION NORTH, ATIKOKAN GS PREOPERATIONAL STUDY, 1983.



1 Keratella cochlearis
2 Polyarthra spp
3 Kellicottia longispina
4 Gastropus spp
5 Asplanchna spp

FIGURE 28
SEASONAL DENSITIES (NO m-3) OF MAIN ROTIFERS AT ANDERSON DAM, ATIKOKAN GS PREOPERATIONAL STUDY, 1983.

Table 24

SPECIES COMPOSITION AND MEAN DENSITIES (No m^{-3}) OF CRUSTACEAN ZOOPLANKTON IN LAKES INCLUDED IN THE ATIKOKAN GS PREOPERATIONAL STUDY - YEAR III, 1983

Taxa	Snow		Icy		Able		Slush		Marmion					
									South		North[a]		Anderson Dam	
	No m^{-3}	%	No m^{-3}	%	No m^{-3}	%	No m^{-3}	%	No m^{-3}	%	No m^{-3}	%	No m^{-3}	%
Diaphanosoma leuchtenbergianum	225.0	0.3	112.5	0.1	225.0	0.3	185.2	0.7	1 084.5	2.7	899.3	2.1	215.0	0.3
Daphnia spp	3 037.5	3.6	1 157.7	1.5	1 698.3	2.2	933.0	3.5	502.7	1.3	1 030.8	2.4	1 175.3	1.7
Daphnia longiremis	1 350.0	1.6	1 074.2	1.4	1 224.2	1.6	439.0	1.7	1 033.3	2.6	631.0	1.5	1 575.0	2.3
Daphnia galeata mendotae	4 687.5	5.6	1 899.2	2.5	4 153.5	5.3	703.5	2.6	3 141.0	7.9	1 425.3	3.3	3 927.5	5.8
Daphnia pulex			37.5	<0.1					26.5	0.1	238.2	0.6		
Daphnia catawba	91.7	0.1	150.0	0.2	463.3	0.6	46.3	0.2	105.8	0.3	105.7	0.2	37.5	0.1
Ceriodaphnia lacustris	337.5	0.4	528.3	0.7			55.2	0.2	264.5	0.7	49.7	0.1	243.3	0.4
Bosmina longirostris	25 387.5	30.3	16 063.2	21.2	3 681.2	4.7	1 874.8	7.1	2 833.8	7.2	6 207.8	14.4	10 782.5	15.9
Chydorus sphaericus	37.5	0.0					449.7	1.7			105.8	0.2	37.5	0.1
Diaptomus oregonensis (adults)	2 812.5	3.4	2 479.3	3.3	4 191.3	5.4	1 947.3	7.3	2 708.0	6.8	2 279.0	5.3	4 013.8	5.9
Diaptomus minutus (adults)	841.7	1.0	518.3	0.7	1 372.7	1.8	416.8	1.6	722.5	1.8	1 060.5	2.5	1 713.0	2.5
Calanoid nauplii (larvae)	9 975.0	11.9	13 529.8	17.8	15 705.7	20.1	4 794.2	18.0	6 022.2	15.2	7 686.7	17.8	8 682.2	12.8
Calanoid copepodites (juveniles)	3 804.2	4.5	2 260.8	3.0	2 074.7	2.7	802.8	3.0	3 936.5	9.9	1 501.3	3.5	1 679.5	2.5
Tropocyclops prasinus (adults)					61.7	0.1								
Cyclops bicuspidatus thomasi (adults)	5 604.2	6.7	5 922.7	7.8	4 761.7	6.1	3 142.5	11.8	3 808.0	9.6	3 701.0	8.6	9 403.2	13.8
Mesocyclops edax (adults)	1 179.2	1.4	1 104.2	1.5	690.2	0.9	396.8	1.5	769.0	1.9	857.3	2.0	2 986.8	4.4
Cyclopoid nauplii (larvae)	17 475.0	20.9	23 223.7	30.6	33 544.3	42.9	8 386.8	31.6	10 254.5	25.9	11 945.2	27.7	16 231.3	23.9
Cyclopoid copepodites (juveniles)	6 900.0	8.2	5 790.2	7.6	4 319.8	5.5	2 004.5	7.5	2 407.5	6.1	3 406.8	7.9	5 304.0	7.8
Mean Total	83 745.8		75 851.5		78 167.5		26 578.5		39 620.2		43 131.5		68 009.5	

cyclopoid copepod found in all lakes was *Mesocyclops edax*, the adults of which occurred in substantially lower numbers than *Diacyclops bicuspidatus thomasi* adults. *Tropocyclops prasinus* adults were only found in low numbers in Abie Lake.

The cladocerans made up from 15 (Abie Lake) to 42% (Snow Lake) of the mean total numbers of crustacean zooplankton. *Bosmina longirostris* was the main cladoceran found at all locations except Abie Lake and Marmion South where *Daphnia galeata mendotae* was slightly more abundant.

The calanoid copepods made up between 21 (Snow Lake) and 34% (Marmion South) of the crustacean zooplankton with *Diaptomus oregonensis* being the most abundant adult form at all locations. *Diaptomus minutus* the only other calanoid copepod identified was also present at all locations.

In 1982 (Ontario Hydro Research Division Report No 84-54-K), the cyclopoid copepods were also found to be the main crustacean zooplankton present at all locations except Snow Lake where the cladocerans were more prominent. The cyclopoid copepods were the most important crustacean zooplankton present in all the lakes included in the 1981 study (Ontario Hydro Research Division Report NO 83-338-K). *Diacyclops bicuspidatus thomasi*, *Diaptomus oregonensis* and *Bosmina longirostris* were also found to be the main cyclopoid copepod, calanoid copepod and cladoceran, respectively, in the 1981 and 1982 studies. Schindler and Noven (1971) found either *Diacyclops bicuspidatus thomasi* or *Diaptomus minutus* to be the numerically dominant crustacean zooplankton in the 45 ELA lakes included in their study. Acres (1976) found *D. bicuspidatus thomasi* to be the dominant cyclopoid copepod and *D. minutus* and *D. sicilis* to be the main calanoid copepods present in the Atikokan study area in 1975-1976. The dominant cladocerans identified by Acres (1976) were *Bosmina longirostris*, *Diaphanosoma brachyurum*, *Daphnia galeata mendotae*, *Chydorus* and *Ceriodaphnia*.

The number of crustacean zooplankton taxa found over the study period ranged from 10 at Abie Lake to 12 at Marmion North.

As with the rotifers higher numbers of crustacean zooplankton were found at Snow, Icy and Abie Lakes than at the Marmion Lake locations and Slush Lake where lowest numbers were found. The mean seasonal total densities for Snow, Icy and Abie Lakes were 83 746, 75 852, and 78 168 m^{-3}, respectively. At Slush Lake, Marmion South, Marmion North and Anderson Dam they were 26 579, 39 620, 43 132 and 68 010 m^{-3}, respectively.

The cyclopoid copepods dominated the crustacean zooplankton of Abie Lake and Marmion North on all sampling dates (Table 25). At Anderson Dam and Marmion South the cyclopoid copepods dominated from May through September. In October *Bosmina longirostris* was the main species present at Anderson Dam while the calanoid copepods dominated at Marmion South. In Snow and Icy Lakes the cyclopoid copepods dominated from May through July and *Bosmina longirostris* dominated from August to October. In Slush Lake the calanoid copepods were dominant in May and June and the cyclopoid copepods dominated on the remaining sampling dates.

In the samples in which the cyclopoid copepods dominated their relative abundance ranged from 30 (Marmion South in August) to 73% (Abie Lake in October). At the time and locations that *Bosmina longirostris* was dominant its relative abundance ranged from 38 to 70% (Snow Lake in August and September, respectively). The calanoid copepods made up from 54 (Marmion South in october) to 58% (Slush Lake in May) of the crustacean zooplankton numbers in the samples in which they dominated.

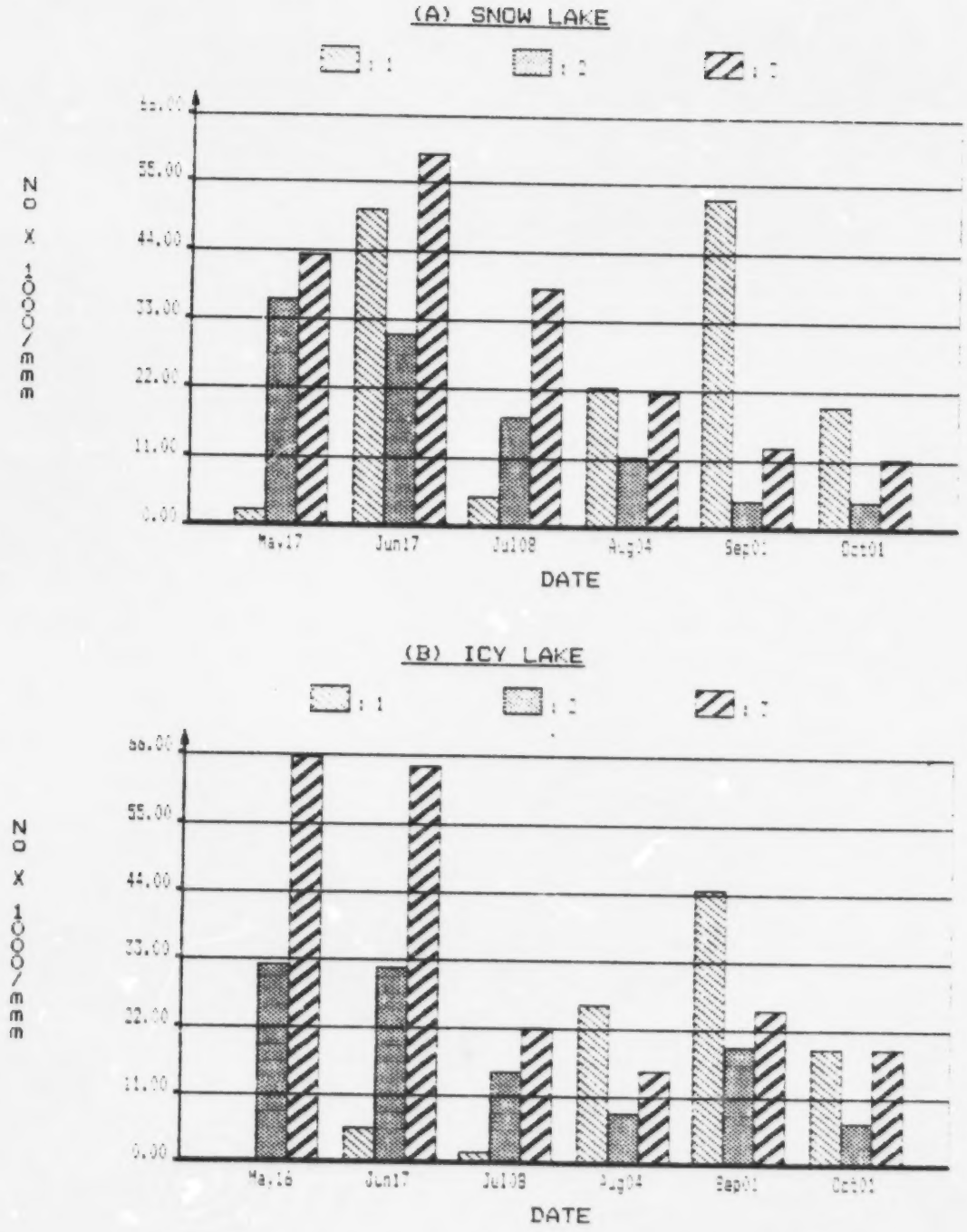
Diacyclops bicuspidatus thomasi was the main adult cyclopoid copepod form and therefore probably the main cyclopoid copepod taxon present on all occasions at the various sampling locations except in June at Anderson Dam when adult *Mesocyclops edax* were more abundant. In most of the samples the cyclopoid copepod numbers consisted predominantly of nauplii. Exceptions were the May Snow Lake sample, the June Abie, Marmion North and Anderson Dam samples, the September Slush Lake sample and the October Slush, Marmion South and Anderson Dam samples. In these samples the cyclopoid copepodites (juveniles and adults) were more abundant than the nauplii.

Consistent trends in the seasonal density distributions of the crustacean zooplankton were not observed (Figures 29 - 32). Maximum numbers of cyclopoid copepods were observed in June in Snow Lake, in May in Icy Lake, in July in Abie Lake and at Marmion South, and in September in Slush Lake and at Marmion North and Anderson Dam. The calanoid copepods were most abundant in May in Snow and Icy Lakes, in July in Abie Lake, in June in Slush Lake, in September at Marmion North and Anderson Dam and in October at Marmion South. Occurrence of maximum densities of *Bosmina longirostris* was more consistent with highest densities found in August/September at all locations except Anderson Dam where highest densities were found in October. Highest peak densities of the cyclopoid copepods were found in Abie Lake in July (74 925 m^{-3}). Highest peak densities of calanoid copepods (36 000 m^{-3}) and *Bosmina longirostris* (52 650 m^{-3}) were found in Snow Lake in May and September, respectively.

Table 25

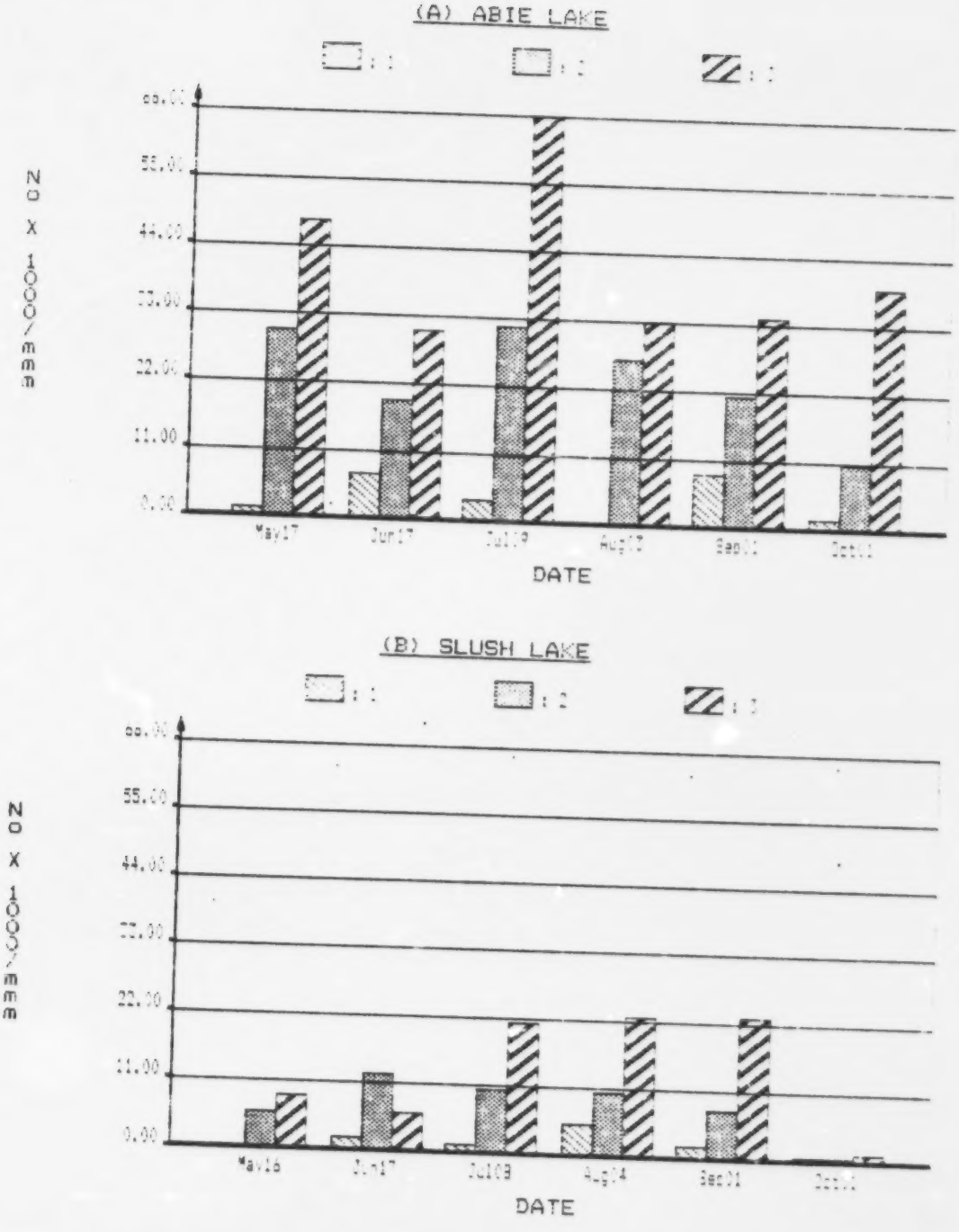
MAIN ZOOPLANKTON PRESENT AT VARIOUS LOCATIONS ON EACH SAMPLING DATE
- ATIKOKAN PREOPERTIONAL STUDY YEAR II, 1983

	May 17	June 17	July 15	August 26	September 21	October 27
Snow Lake	Cyclopoid copepods (52%) Calanoid copepods (44%)	Cyclopoid copepods (37%) Bosmina longirostris (3%)	Cyclopoid copepods (44%) Calanoid copepods (20%)	Bosmina longirostris (35%) Cyclopoid copepods (37%) Calanoid copepods (20%)	Bosmina longirostris (70%) Cyclopoid copepods (17%) Calanoid copepods (6%)	Bosmina longirostris (52%) Cyclopoid copepods (31%) Calanoid copepods (12%)
Icy Lake	Cyclopoid copepods (67%) Calanoid copepods (33%)	Cyclopoid copepods (59%) Calanoid copepods (29%)	Cyclopoid copepods (45%) Calanoid copepods (30%)	Bosmina longirostris (49%) Cyclopoid copepods (28%)	Bosmina longirostris (46%) Cyclopoid copepods (31%)	Bosmina longirostris (39%) Cyclopoid copepods (37%)
Able Lake	Cyclopoid copepods (60%) Calanoid copepods (38%)	Cyclopoid copepods (44%) Calanoid copepods (22%)	Cyclopoid copepods (62%) Calanoid copepods (26%)	Cyclopoid copepods (46%) Calanoid copepods (37%)	Cyclopoid copepods (48%) Calanoid copepods (30%)	Cyclopoid copepods (3%) Calanoid copepods (20%)
Slush Lake	Calanoid copepods (58%) Calanoid copepods (39%)	Calanoid copepods (57%) Cyclopoid copepods (29%)	Cyclopoid copepods (61%) Calanoid copepods (30%)	Cyclopoid copepods (52%) Calanoid copepods (24%)	Cyclopoid copepods (56%) Calanoid copepods (20%)	Cyclopoid copepods (45%) Calanoid copepods (25%)
Harmion South	Cyclopoid copepods (59%) Calanoid copepods (39%)	Cyclopoid copepods (54%) Calanoid copepods (40%)	Cyclopoid copepods (43%) Calanoid copepods (24%)	Cyclopoid copepods (30%) Calanoid copepods (27%) Bosmina longirostris (25%)	Cyclopoid copepods (47%) Calanoid copepods (20%)	Calanoid copepods (54%) Cyclopoid copepods (41%)
Harmion North	Cyclopoid copepods (58%) Calanoid copepods (39%)	Cyclopoid copepods (56%) Calanoid copepods (26%)	Cyclopoid copepods (53%) Calanoid copepods (28%)	Cyclopoid copepods (33%) Calanoid copepods (29%) Bosmina longirostris (29%)	Cyclopoid copepods (42%) Calanoid copepods (27%)	Cyclopoid copepods (57%) Calanoid copepods (37%)
Anderson Dam	Cyclopoid copepods (48%) Calanoid copepods (46%)	Cyclopoid copepods (48%) Calanoid copepods (17%)	Cyclopoid copepods (44%) Calanoid copepods (35%)	Cyclopoid copepods (62%) Calanoid copepods (30%)	Cyclopoid copepods (46%) Calanoid copepods (30%)	Bosmina longirostris (40%) Cyclopoid copepods (38%)



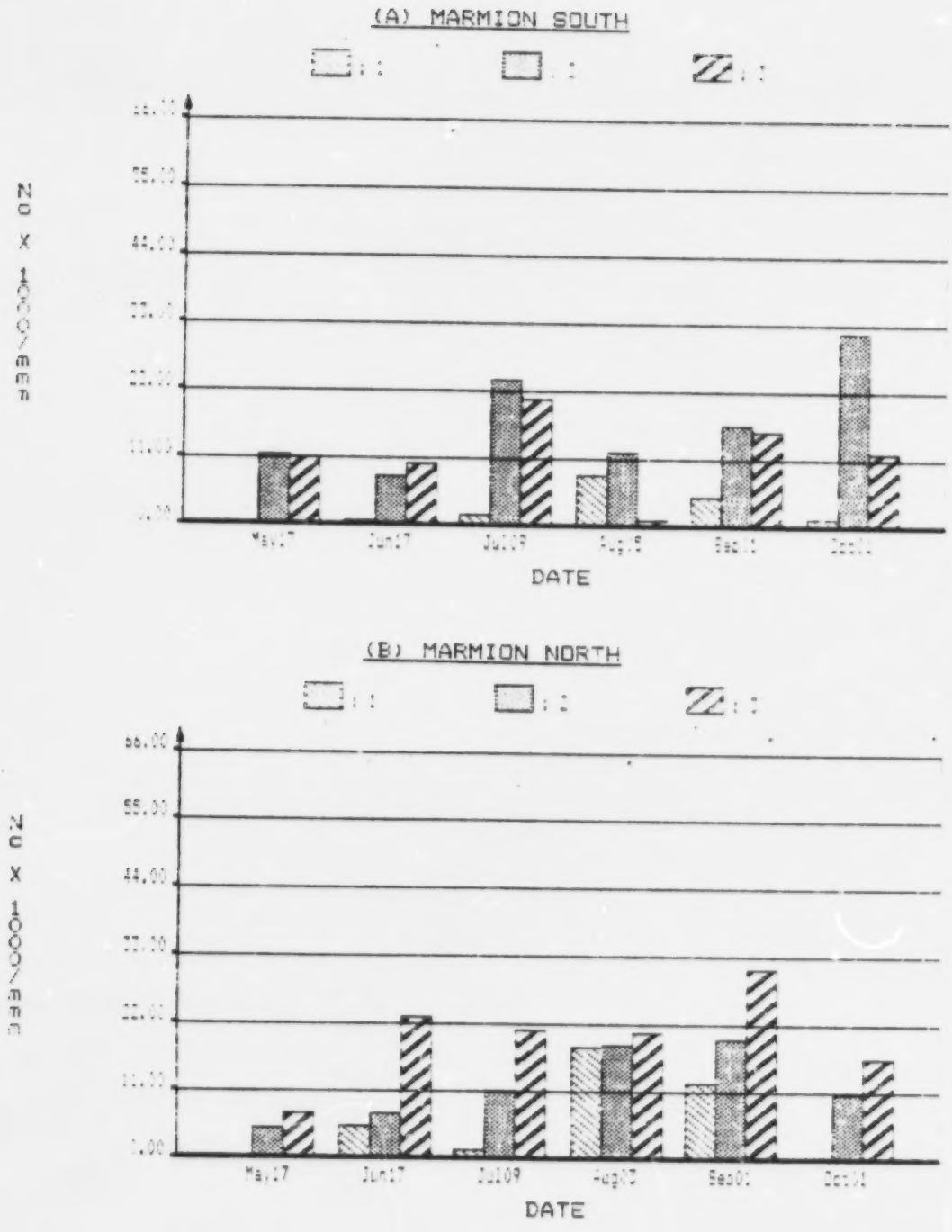
1 Bosmina longirostris
2 Calanoid copepods (nauplii and copepodites)
3 Cyclopoid copepods (nauplii and copepodites)

FIGURE 29
SEASONAL DENSITIES (NO m-3) OF MAIN CRUSTACEAN ZOOPLANKTON IN (A) SNOW LAKE AND (B) ICY LAKE, ATIKOKAN GS PREOPERATIONAL STUDY, 1983.



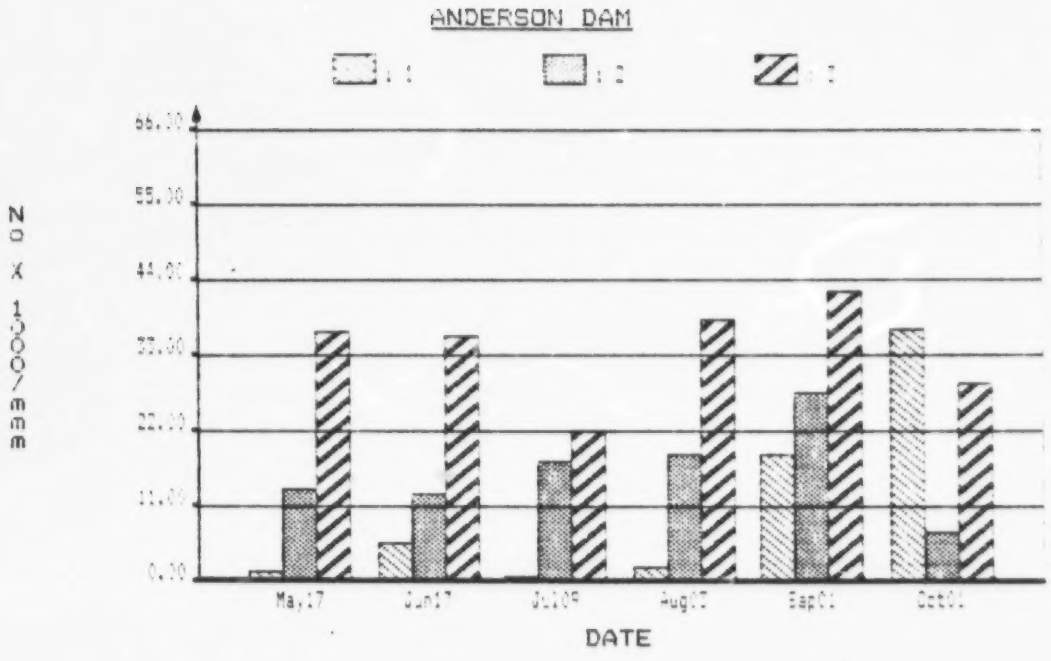
1 Bosmina longirostris
2 Calanoid copepods (nauplii and copepodites)
3 Cyclopoid copepods (nauplii and copepodites)

FIGURE 30
SEASONAL DENSITIES (NO m-3) OF MAIN CRUSTACEAN ZOOPLANKTON IN (A) ABIE LAKE AND (B) SLUSH LAKE, ATIKOKAN GS PREOPERATIONAL STUDY, 1983.



1 Bosmina longirostris
2 Calanoid copepods (nauplii and copepodites)
3 Cyclopoid copepods (nauplii and copepodites)

FIGURE 31
SEASONAL DENSITIES (NO m-3) OF MAIN CRUSTACEAN ZOOPLANKTON
(A) MARMION SOUTH AND (B) MARMION NORTH, ATIKOKAN GS
PREOPERATIONAL STUDY, 1983.



1 Bosmina longirostris
2 Calanoid copepods (nauplii and copepodites)
3 Cyclopoid copepods (nauplii and copepodites)

FIGURE 32
SEASONAL DENSITIES (NO m-3) OF MAIN CRUSTACEAN ZOOPLANKTON AT ANDERSON DAM, ATIKOKAN GS PREOPERATIONAL STUDY, 1983.

Densities of Zooplankton by Size Category

Zooplankton samples collected in Icy Lake in May, June and July of 1983 were passed through a series of four sieves to determine the size distribution of the zooplankton. The mesh size of the sieves were 64, 160, 243 and 320 µm. The smallest mesh size used was the mesh size of the netting on the Schindler-Patalas plankton trap used to collect the samples. In field sampling considerable clogging of the net can occur resulting in inefficient filtering of the sample and animals smaller than 64 µm are captured. However, when passing samples through sieves in the laboratory intensive washing of the material on the mesh makes the laboratory sieving process more efficient than the field filtering and the fraction smaller than 64 µm is not retained. This accounts for the differences in the seasonal density estimates and the densities of animals larger than 64 µm.

The densities of the zooplankton collected at the seven sampling locations are presented by size category for May, June and July in Figure 33. In most samples the largest proportion of the animals were in the 64 to 160 µm category. The proportion of smaller animals in this size category was lower in July than in May and June, while the percentage of large animals, >320 µm, was higher in July than in the previous two months. Most of the rotifers and copepod nauplii were found in the 64 to 160 µm category while most of the cladocerans and adult copepods were found in the 243 to 320 µm and >320 µm size ranges. The most obvious difference in the size distribution of the zooplankton of the various lakes sampled was found in June when Icy Lake had a substantially lower proportion of animals in the 64 - 160 µm range and a higher percentage of animals in the 160 - 240 µm range than the remaining lakes.

3.2.4 Emergence Traps

As many of the emergence traps set during 1983 were vandalized, analysis of the results will be limited to a description of the composition of the emergence trap catches and a few general comments on insect production based on an incomplete data set.

There were 38 taxa identified in the emergence traps of which four taxa were incidental non-insects (Table 26). Midges (family Chironomidae) were the most frequently occurring insects in all habitats sampled comprising greater than 80% of the insects. The composition of insects did not vary substantially with habitat and depth. This lack of difference with depth is probably related to the level of identification (ie family). Similarly there was little variation in composition with date sampled.

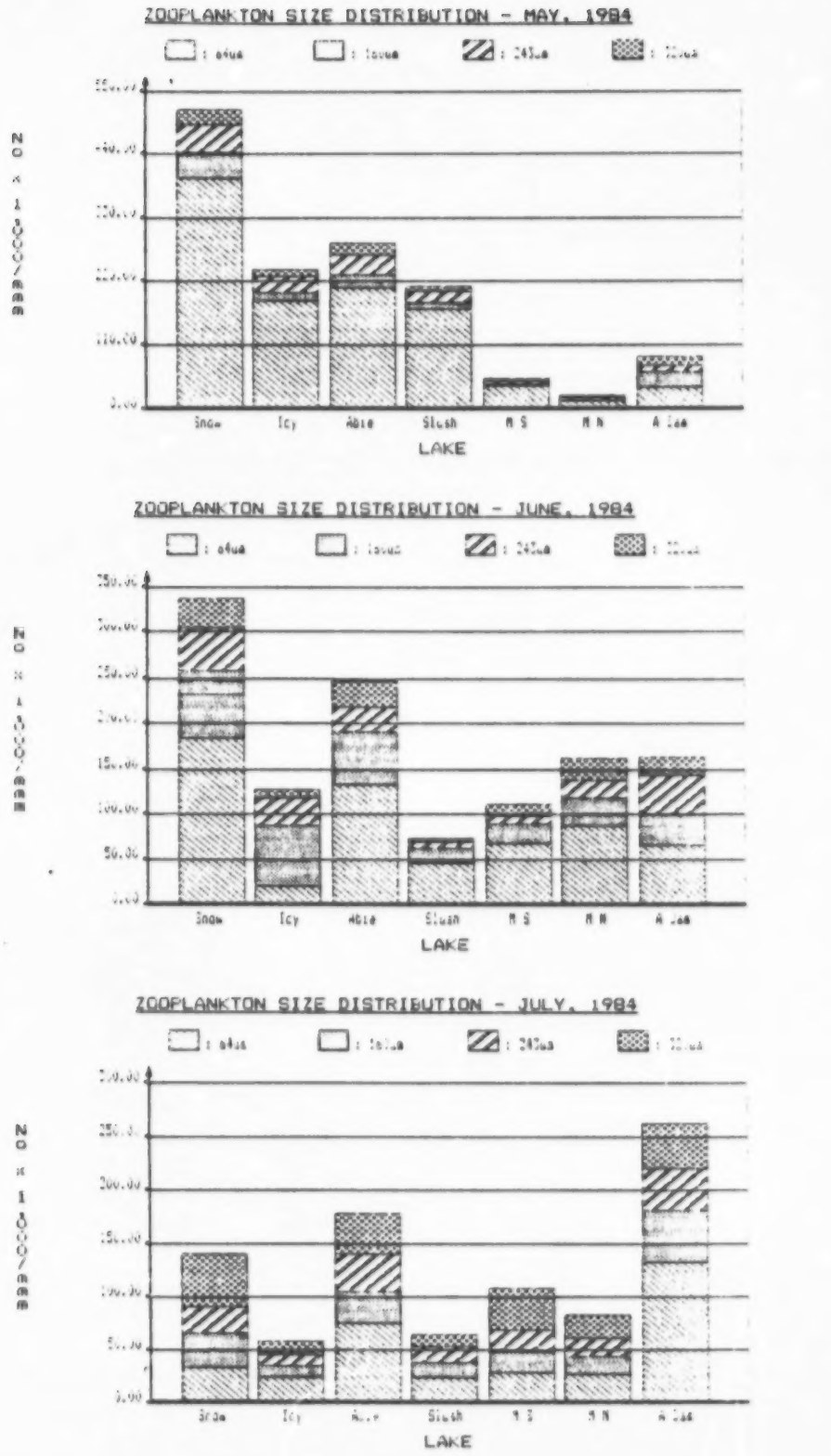

ZOOPLANKTON SIZE DISTRIBUTION - MAY, 1984
ZOOPLANKTON SIZE DISTRIBUTION - JUNE, 1984
ZOOPLANKTON SIZE DISTRIBUTION - JULY, 1984
LAKE

FIGURE 33

ESTIMATED SIZE DISTRIBUTION OF ZOOPLANKTON
ATIKOKAN MAY - JULY 1983

Table 26

COMPOSITION OF INVERTEBRATES COLLECTED IN EMERGENCE TRAPS

	3 m Vegetated	3 m Non-Vegetated	7 m	Maximum Depth	Totals
Diptera					
Chironomidae	1 616 (85.2)	2 049 (83.1)	385 (48.1)	488 (88.4)	4 538 (79.4)
Ceratopogonidae	183 (9.6)	228 (8.9	5 (0.6)	6 (1.1)	414 (7.2)
Phoridae	34 (1.8)	27 (1.1)	8 (1.0)	38 (6.9)	107 (1.9)
Ephydridae	3 (0.2)				
Chaoboridae					
Chaoborus sp				1 (0.2)	1 (0.0)
Ceridomyidae				1 (0.2)	1 (0.0)
Trichoptera		1 (0.0)		1 (0.2)	2 (0.0)
Hydropsychidae	1 (0.1)	2 (0.1)			3 (0.1)
Hydroptilidae	1 (0.1)	13 (0.5)			14 (0.2)
Psychomyiidae	3 (0.2)	6 (0.2)		1 (0.2)	10 (0.2)
Leptoceridae	1 (0.1)	4 (0.2)		1 (0.2)	6 (0.1)
Molannidae		1 (0.0)			1 (0.0)
Philopotamidae	16 (0.8)	107 (4.3)		3 (0.5)	126 (2.2)
Agraylea sp	3 (0.2)				3 (0.1)
Phryganeidae	8 (0.4)				8 (0.1)
Agrypnia sp	2 (0.1)				2 (0.0)
Limnephilidae	1 (0.1)				1 (0.0)
Coleoptera					
Haliplidae					
Haliplus sp		3 (0.1)	1 (0.1)	2 (0.4)	6 (0.1)
Hydrophidae		1 (0.0)			1 (0.0)
Dytiscidae		1 (0.0)			1 (0.0)
Gyrinidae					
Gyrinus sp	2 (0.1)	5 (0.2)		2 (0.4)	9 (0.2)
Curculionidal	1 (0.1)				1 (0.0)
Chrysomelidae	2 (0.1)			1 (0.2)	3 (0.1)
Ephemeroptera	3 (0.2)	7 (0.3)		1 (0.2)	11 (0.2)
Caenidae		3 (0.1)			3 (0.1)
Caenis sp	1 (0.1)				1 (0.0)
Heptageniidae		1 (0.0)			1 (0.0)
Ephemeridae	3 (0.2)	1 (0.0)			4 (0.1)
Ephemerella sp		1 (0.0)			1 (0.0)
Lepidoptera					
Pyralidae		2 (0.1)			2 (0.0)
Neuroptera					
Climacea sp				3 (0.5)	3 (0.1)
Hemoptera		1 (0.0)			1 (0.0)
Hymenoptera		1 (0.0)			1 (0.0)
Formicidae	1 (0.1)				1 (0.0)
Odonata					
Zygoptera					
Coenagrionidae		1 (0.0)		1 (0.2)	2 (0.0)
Acarina	1 (0.1)	1 (0.0)	401 (50.1)	1 (0.2)	404 (7.1)
Amphipoda					
Hyalella azteca	8 (0.4)	8 (0.3)		1 (0.2)	17 (0.3)
Mollusca					
Lymnaea sp	2 (0.1)				2 (0.0)
Physa sp	1 (0.1)				1 (0.0)
Total	1 897	2 467	800	552	5 716

In terms of biomass (Table 27) samples collected at the 3 m vegetated locations were generally highest while those from the maximum depth location were generally lowest. On a monthly basis production tended to be higher in June, July and August than in September. The high variation among monthly means reflects the substantial differences in the biomass of samples from different basins within months. The seasonal and spatial trends observed for all locations (Table 27) were consistent with the trends observed for the only basin for which a complete data set was available (Snow Lake, Table 28).

3.2.5 Fish

Larval Fish

The results of larval tows are in Appendix 5. There were 902 fish collected between May 12 and July 12, 1983. Unidentified Cyprinidae were the most common (41%) of the nine taxa collected (Table 29). Yellow perch which was the most abundant species in 1981 sampling was the second most common species in 1983. Cisco and ninespine stickleback larvae which were absent in 1981 were collected in 1983 while walleye and logperch which were collected in 1981 were absent in 1983. Cisco, although not collected as part of this study in 1981, were collected in Snow Lake as part of another study (Ontario Hydro Research Division Report No C83-74-K). Cyprinidae were collected at all locations except Slush Lake while yellow perch were collected at all locations except Marmion North.

The temperature range and dates during which each species was present in the catch is compared with similar data from 1981 in Figure 34. Although the initial collection dates were similar in the two years, the temperature was 3 to 4°C cooler in 1983 than in 1981. This lower temperature in 1983 probably accounts for the increased abundance of larval cisco and lake whitefish in the 1983 collections. No cisco and only one lake whitefish was collected in 1981 compared to 109 cisco and 11 lake whitefish in 1983. The majority of cisco (106) were collected from Slush Lake which was not sampled during 1981.

Beach Seines

There were 14 342 fish caught in beach seines during 1983 (Appendix 6, Table 30). Mimic shiner (37%) was the most frequently captured species of the 21 taxa caught. Blacknose shiner (31%) and yellow perch (15%) were also relatively abundant. Young-of-the-year walleye and northern pike were also included in the catch. The species composition of beach seine catches in vegetated and non-vegetated areas was not substantially different.

TABLE 27

BIOMASS (mg/m^2 dry weight ± 1 SD) OF EMERGENCE TRAP SAMPLES BY MONTH
(all basins combined)

Month Sampled	3 m Vegetated	3 m Non-Vegetaged	7 m	Maximum Depth
June	74.4 ± 80.8	59.2 ± 46.8	191.6 ± 192.8	19.6 ± 17.6
July	211.6 ± 197.6	179.2 ± 96.0	69.2[1]	62.0 ± 65.5
August	528.8 ± 711.6	93.6 ± 116.0	48.8[1]	31.2 ± 26.8
September 1	68.0 ± 51.2	35.2 ± 13.2	114.8[1]	18.0 ± 7.2
September 25-26	20.8 ± 8.4	16.8 ± 14.0	47.2[1]	12.0 ± 12.4
Mean	180.8	76.8	94.0	28.4

TABLE 28

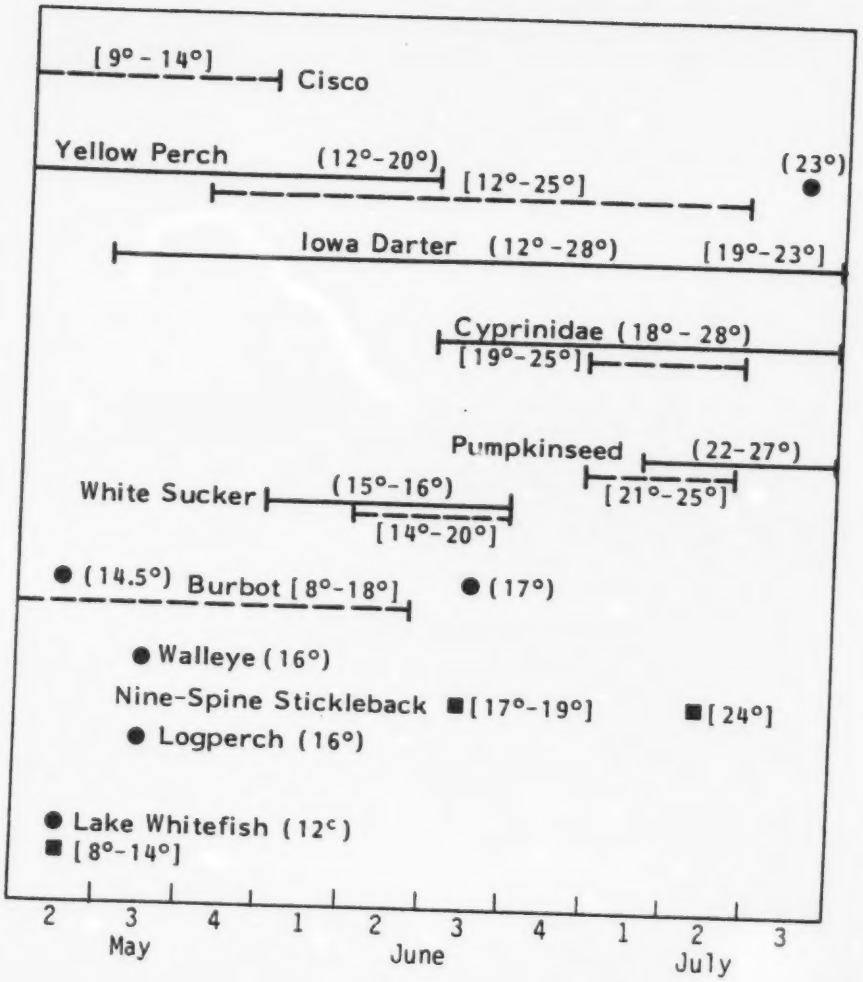
BIOMASS (mg/m^2 dry weight ± 1 SD) OF
EMERGENCE TRAP SAMPLES BY DATE (SNOW LAKE)

Date Sampled	3 m Vegetated	3 m Non-Vegetaged	7 m	Maximum Depth
June 13	197.2	148.4	55.2	7.2
July 7	466.0	161.2	69.2	10.0
August 4	1 346.4	15.6	48.8	22.4
September 1	134.8	29.2	114.8	26.8
September 26	26.4	26.4	47.2	24.8
Mean	434.1	76.2	67.0	18.2

Table 29

LARVAL FISH CATCH [NUMBER AND (PER CENT)] ATIKOKAN 1983

Species	Snow Lake	Snow Outlet	Icy Lake	Icy Outlet	Abie Lake	Abie Outlet	Slush Lake	Marmion Lake					Moose Lake	Total
								South	Central	North	Anderson Dam	Lower Seine		
Cyprinidae	16 (21.9)	5 (19.2)	3 (11.5)	8 (8.3)	193 (95.1)	74 (76.3)	0	6 (54.5)	2 (15.4)	29 (78.4)	1 (20.0)	3 (18.8)	31 (23.8)	371 (41.1)
Yellow Perch	31 (42.5)	14 (53.8)	17 (65.4)	49 (51.0)	2 (1.0)	12 (12.4)	63 (37.3)	1 (9.1)	4 (30.8)	0	1 (20.0)	10 (62.5)	94 (72.3)	298 (33.0)
Cisco	2 (2.7)	0	0	0	0	0	106 (62.7)	0	0	0	1 (20.0)	0	0	109 (12.1)
Pumpkinseed	23 (31.5)	7 (26.9)	4 (15.4)	16 (16.7)	5 (2.5)	7 (7.2)	0	0	1 (7.7)	0	0	1 (6.3)	0	64 (7.1)
White Sucker	1 (1.4)	0	2 (7.7)	22 (22.9)	1 (0.5)	0	0	0	0	0	0	1 (6.3)	1 (0.8)	28 (3.1)
Iowa Darter	0	0	0	0	0	3 (3.1)	0	0	2 (15.4)	8 (21.6)	0	0	0	13 (1.4)
Lake Whitefish	0	0	0	0	0	1 (1.0)	0	2 (18.2)	3 (23.1)	0	2 (40.0)	1 (6.3)	2 (1.5)	11 (1.2)
Ninespine Stickleback	0	0	0	1 (1.0)	1 (0.5)	0	0	1 (9.1)	1 (7.7)	0	0	0	0	4 (0.4)
Burbot	0	0	0	0	1 (0.5)	0	0	0	0	0	0	0	2 (1.5)	3 (0.3)
Corregonid egg	0	0	0	0	0	0	0	1 (9.1)	0	0	0	0	0	1 (0.1)
Total	73	26	26	96	203	97	169	11	13	37	5	16	130	902



1981 ( ) ●

1983 [ ] ■

FIGURE 34

OCCURRENCE OF LARVAL FISH
RELATIVE TO DATE AND TEMPERATURE
ATIKOKAN 1981, 1983

Table 30

HUMBER AND % COMPOSITION OF FISH CAUGHT IN BEACH SEINES - ATIKOKAN 1983

Species	Snow Lake				Icy Lake				Abie Lake				Slush Lake				Lower Seine			
	Veg		Non-Veg		Veg		Non-Veg		Veg		Non-Veg		Veg		Non-Veg		Veg		Non-Veg	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Mimic Shiner	996	73	692	46	1	0	18	3	505	43	398	33					98	30	1 142	75
Blacknose Shiner	125	9	290	19	67	7	219	35	542	46	640	54	193	100	92	99	22	7	46	3
Yellow Perch	157	11	205	14	770	79	122	19	13	1	6	1					35	11	46	3
Iowa Darter	40	3	103	7	8	1	38	6	11	1	9	1			1	1	149	45	205	13
Logperch					7	1	28	4			1	0					3	1	16	1
White Sucker	11	1	12	1	4	0	45	7	41	3	8	1					10	3	33	2
Spottail Shiner					70	7	81	13	25	2	14	1					1	0	23	2
Pumpkinseed	9	1	33	2	45	5	54	9	29	2	33	3					3	1	3	0
Cyprinidae	19	1	139	9	3	0					62	5					2	1		
Golden Shiner	7	1	10	1			3	0	1	0	14	1					8	2		
Lake Chub	3	0	6	0			5	1											1	0
Longnose Dace					1	0	11	2												
Slimy Sculpin	1	0																	6	0
Walleye									4	0	1	0								
Fathead Minnow							2	0											3	0
Redbelly Dace											1	0							4	0
Ninespine Stickleback																				
Northern Pike									1	0	1	0								
Burbot									0	0	1	0					1	0		
Central Mudminnow																				
Notropis sp																				
Totals	1 368		1 490		976		626		1 172		1 189		193		93		332		1 529	

Species	Harmion Lake										Anderson Dam		Moose Lake		Total					
	South				Central				North											
	Veg		Non-Veg		Veg		Non-Veg		Veg		Non-Veg		Veg		Non-Veg		Veg		Non-Veg		All	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Mimic Shiner	102	31	255	36	498	99	79	87	10	3	188	17	44	11	256	21	2	2	25	3	2 256	39	3 053	35	5 309	37
Blacknose Shiner	57	17	230	32			1	1	288	84	550	49	164	42	412	34	96	82	418	76	1 554	27	2 898	34	4 452	31
Yellow Perch	79	24	149	21	4	1	10	11	38	11	272	24	125	32	120	10	1	1	16	3	1 222	21	946	11	2 168	15
Iowa Darter	23	7	12	2									5	1	3	0	15	13	20	4	251	4	391	5	642	4
Logperch	1	0	1	0									18	5	391	32	3	3	2	0	32	1	439	5	471	3
White Sucker	1	0	16	2					3	1	116	10	2	1	9	1					72	1	239	3	311	2
Spottail Shiner	9	3	28	4	3	1					2	0	12	3	22	2					120	2	170	2	290	2
Pumpkinseed																					111	2	129	1	240	2
Cyprinidae	10	3	4	1							2	0	15	4							24	0	201	2	225	2
Golden Shiner																					60	1	107	1	167	1
Lake Chub	43	13	12	2					1	0									68	12						
Longnose Dace																			1	0	4	0	12	0	16	0
Slimy Sculpin																					1	0	11	0	12	0
Walleye			1	0																	1	0	7	0	8	0
Fathead Minnow															2	0					4	0	3	0	7	0
Redbelly Dace							1	1					1	0							1	0	6	0	7	0
Ninespine Stickleback			1	0											1	0					0	0	6	0	6	0
Northern Pike			3	0					1	0											1	0	4	0	5	0
Burbot																					2	0	1	0	3	0
Central Mudminnow																					0	0	1	0	1	0
Notropis sp																					1	0	0	0	1	0
Totals	326		712		505		91		341		1 130		386		1 216		117		550		5 717		8 625		14 342	

85-81

The three main species were collected from each sampling area with the exception of mimic shiner and yellow perch which were absent from the catch in Slush Lake. Mimic shiner was the most common species in the catch from Snow Lake, Lower Seine, Marmion South and Central while blacknose shiner was most common in Abie, Slush and Moose Lakes, Marmion North and Anderson Dam and yellow perch was the most abundant species in Icy Lake.

Walleye young-of-the-year were seined in Abie Lake and at Anderson Dam while northern pike were collected in Abie Lake and Marmion South. Unlike 1981 no young-of-the-year coregonids were seined.

The catch per unit effort of the abundant species varied substantially with date and location (Appendix 7, Table 31). As in 1981 the catch per unit effort of all taxa in the upper lakes was greater than that in Marmion Lake, however, the catch per unit effort in 1983 was substantially below that in 1981 indicative of the patchy distribution of the near-shore fish community.

The catch in beach seines varied substantially among months but was generally lowest in May and late October. There was no consistent difference in the catch per beach seine among vegetated and non-vegetated sites.

Gill Nets

The catch in gill nets is listed in Appendix 7 and summarized in Table 32. The catch of 644 fish contained seven species of which cisco was the most abundant (31%). Cisco was the most common species in Snow, Abie and Slush Lakes and at Marmion North, while white sucker was the most abundant in Icy Lake and at Marmion Central and Anderson Dam; lake whitefish was the most common at Marmion South and Lower Seine, and northern pike was the most common in Moose Lake.

The catch was largest at Anderson Dam (108 fish) and lowest in Moose Lake (9 fish). The small catch in Moose Lake is probably partially due to the refilling of that basin resulting in dilution of the fish community. As a result of this dilution the impingement records of the station should increase over the first few years of operation as fish numbers increase in Moose Lake.

The composition of the catch did not vary substantially from that of 1982 but did, however, differ from that of 1981 when trap nets were used to sample adult fish. Coregonids were not adequately sampled in the trap nets set in 1981.

Table 31

CATCH PER BEACH SEINE OF ABUNDANT AND SPORT FISH - ATIKOKAN 1983

	May 9 - 13		June 7 - 13		July 7 - 8		Aug 3 - 4		Sept 1		Oct 1		Oct 25 - 26		All Dates		
	Veg	Non-Veg	Veg	Non-Veg	Veg	Non-Veg	Veg	Non-Veg	Veg	Non-Veg	Veg	Non-Veg	Veg	Non-Veg	Veg	Non-Veg	Total
Upper Lakes[1]																	
Mimic Shiner	0.3	0.0	0.3	2.8	0.0	0.2	0.0	1.3	341.0	146.7	156.7	39.2	0.0	0.0	71.2	41.7	51.5
Blacknose Shiner	12.0	1.7	1.0	24.0	95.7	31.0	85.7	90.7	19.0	41.5	7.0	4.0	20.3	0.8	34.4	27.7	29.9
Yellow Perch	1.3	1.0	236.3	0.5	7.3	16.8	25.3	15.5	36.3	16.2	0.3	1.2	2.0	0.0	44.1	7.3	19.6
Walleye[2]	0.0	0.0	0.0	0.0	2.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.1
Northern Pike	0.0	0.0	0.0	0.0	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
All Species	22.0	6.7	241.3	30.8	122.7	61.2	132.3	165.2	436.0	231.7	189.7	52.7	29.0	2.8	167.6	78.7	108.3
Marmion Lake																	
Mimic Shiner	0.0	0.1	2.4	4.4	0.0	3.8	9.0	27.1	100.2	22.0	38.4	20.6	3.2	114.0	21.9	27.4	25.6
Blacknose Shiner	0.2	3.6	28.4	0.3	7.4	52.2	23.0	51.4	46.2	13.9	0.2	2.5	0.8	0.0	15.2	17.7	16.9
Yellow Perch	0.8	0.5	2.2	0.0	1.0	6.2	27.2	39.8	5.2	4.2	10.4	7.4	9.4	0.6	8.0	8.4	8.3
Walleye	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Northern Pike	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
All Species	5.4	7.2	36.0	5.8	23.2	93.7	75.8	138.0	172.4	75.7	50.4	30.8	14.2	115.8	53.9	66.7	62.4

[1] Snow, Icy and Abie Lakes
[2] Icy and Abie Lakes only

TABLE 32

SUMMARY OF GILL NET CATCHES - ATIKOKAN 1983

Species	Snow Lake	Icy Lake	Abie Lake	Slush Lake	Marmion Lake						All Locations
					South	Central	North	Lower Seine	Anderson Dam	Moose Lake	
Cisco	31 (60)[1]	26 (29)	30 (43)	33 (79)	21 (25)	12 (16)	16 (33)	8 (12)	21 (19)	1 (11)	199 (31)
White Sucker	13 (25)	36 (40)	12 (17)	5 (12)	9 (12)	25 (33)	11 (22)	6 (9)	33 (31)		150 (23)
Lake Whitefish		2 (2)	9 (13)		38 (46)	13 (17)	5 (10)	29 (45)	7 (6)	3 (33)	106 (16)
Walleye		15 (16)	8 (12)		9 (11)	13 (17)	10 (20)	12 (18)	32 (30)		99 (15)
Northern Pike	2 (4)	10 (11)	10 (14)	3 (7)	5 (6)	12 (16)	7 (14)	8 (12)	14 (13)	5 (56)	76 (12)
Yellow Perch	6 (12)	2 (2)			1 (1)	1 (1)		2 (3)	1 (1)		13 (2)
Burbot				1 (2)							1 (0)
Total	52	91	69	42	83	76	49	65	108	9	644

1 number and (per cent)

Among the catch were six walleye and two white sucker which had a tumor-like growth on their sides. The nature of the growth has yet to be determined.

The catch per 2 h gill net set (Table 33) was marginally higher in Marmion Lake than in the upper lakes but did not vary consistently among months. The trend for higher catches in Marmion Lake than in the Upper Lakes is consistent with the results of 1982.

Spawning

Observations were made during the night at several traditional and potential walleye spawning areas. The number of fish observed in these areas is listed in Table 34. Relatively large aggregations of walleye (>10) were observed on the first observation night (May 3) at Anderson Dam and at the culvert separating Ski and Icy Lakes and as late as May 13 at the Spillway Dam. Relatively large numbers of walleye, suggestive of spawning activity, were observed at Marmion North and at the two locations noted above. Although no walleye were observed at the outflow of Husband Lake into Lower Seine, the remains of several walleye probably predated by bald eagles were observed at that location. Similar observations were made at the Spillway Dam.

In addition to observations of walleye, spawning activity of northern pike, white sucker and yellow perch were also observed. Northern pike were observed at the Icy Lake culvert, the Icy to Abie Lake channel and in Icy lake at the outflow of Snow Lake. Large numbers of white sucker were observed at the Icy Lake culvert, the Icy to Abie Lake channel, in Lower Seine at the outflow of Husband Lake and in Slush Lake at the outflow into Icy Lake. Yellow perch were only observed at the Icy Lake culvert.

Fecundity

Eleven gravid walleye, four northern pike and three cisco were collected for fecundity analysis. The mean numbers of eggs in female walleye, pike and cisco were approximately 88 000 ± 64 000 (SD), 14 000 ± 5 000 and 14 000 ± 7 000, respectively. The large standard deviations are probably indicative of the size-fecundity relationship in fish and the possibility of the inclusion of partially spent fish in our sample.

Figure 35 illustrates the relationship between fork-length and weight and fecundity. Although variability was high it appears that larger walleye produce larger numbers of eggs.

TABLE 33

NUMBER AND CATCH PER 2-h GILL NET SET ATIKOKAN 1983

	May		June		July		August		Sept		Oct		Nov		Average	
UPPER LAKES																
Hours	19.8		17.5		9.0		13		22.0		20.3		11.1		112.7	
White Sucker	3	0.3	9	1.0	6	1.3	3	0.5	14	1.3	11	1.1	19	3.4	65	1.2
Cisco	44	4.4	35	4.0	4	0.9	3	0.5	15	1.4	8	0.8	11	2.0	110	2.0
Northern Pike	4	0.4	6	0.7	1	0.2	5	0.3	1	0.1	7	0.7	5	0.9	29	0.5
Walleye[1]	2	0.4	5	1.0	1	0.4	3	0.9	4	0.7	3	0.6	5	1.7	23	0.8
Yellow Perch	0	0.0	1	0.1	0	0.0	0	0.0	1	0.1	2	0.2	0	0.0	4	0.1
Lake Whitefish	0	0.0	9	1.0	1	0.2	0	0.0	1	0.1	0	0.0	0	0.0	11	0.2
Burbot	0	0.0	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.0
	53	5.4	66	7.9	13	3.0	14	1.8	36	3.4	31	3.1	40	7.2	243	4.3
MARMION																
Hours	22.5		22.0		13.5		12.5		26.8		24.1		12.7		134.1	
White Sucker	24	2.1	6	0.6	19	2.8	7	1.1	13	1.0	14	1.2	6	0.9	89	1.3
Cisco	6	0.5	15	1.4	3	0.4	16	2.6	3	0.2	27	2.2	4	0.6	74	1.1
Northern Pike	6	0.5	10	0.9	1	0.1	1	0.2	5	0.4	16	1.3	3	0.5	42	0.6
Walleye	13	1.2	14	1.3	8	1.2	0	0.0	7	0.5	28	2.3	6	0.9	76	1.1
Yellow Perch	0	0.0	2	0.2	1	0.1	0	0.0	1	0.1	4	0.3	0	0.0	8	0.2
Lake Whitefish	16	1.4	43	3.9	9	1.3	6	1.0	4	0.3	9	0.7	5	0.8	92	1.4
	65	5.7	90	8.3	41	5.9	30	4.9	33	2.5	98	8.0	24	3.7	381	5.7

[1] Icy and Abie Lakes only

TABLE 34

NUMBER OF WALLEYE OBSERVED AT TRADITIONAL AND POTENTIAL SPAWNING SITES

Date	West Dam	North Twin Lake Culvert	Anderson Dam	Spillway Dam	Ski Lake Culvert	Slush Lake Outflow	Icy Lake Outflow	Abie Lake Outflow	Husband Lake Outflow	Snow Lake Outflow
May 3	0	0	13		10		0	0		0
4	11		14		19		0	0		0
5	30-35		11							
7	11-15		7-9	10-20	3		0	0		0
8			2		2	1	1	0	0	0
9	11-12	0	4		5	2	1	0		0
10	6		0	60-70	1					
12									0	
13	0	0	0	15	2	0		0		0
14	0	0			1	0				0

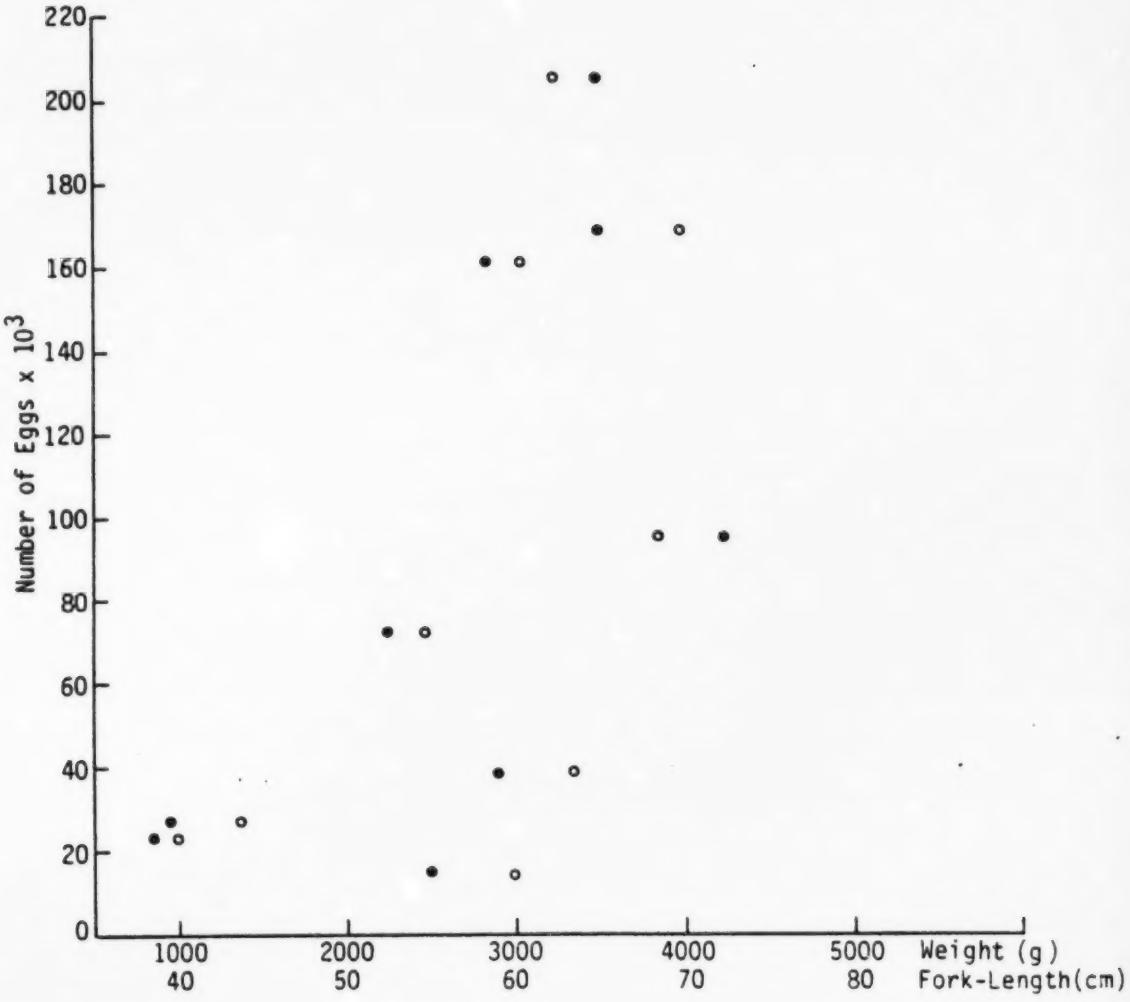


FIGURE 35

PLOT OF WALLEYE FECUNDITY
VERSUS WEIGHT (•) AND FORK-LENGTH (○)

Scott and Crossman (1973) in quoting other sources state that the fecundity of walleye can be as high as 612 000 eggs for an 80 cm fish, 32 000 eggs for an "average" pike and range from 6 000 eggs in Lake Superior to 29 000 eggs in Lake Erie for a 30 cm cisco. The largest number of eggs measured in our sample (205 000 eggs) was from a 30 cm walleye. The 14 000 egg average for cisco agrees reasonably well with the range of fecundities quoted by Scott and Crossman (1973), however that for northern pike suggests that our sample contained individuals which may have been partially spent. As pike deposit small numbers of eggs over several days (Scott and Crossman 1973) this collection of partially spent pike in spawning areas appears likely.

Age and Growth

A subsample of the scales collected from the four major species at Atikokan have been analyzed to date. The remainder of the scales collected during 1983 will be included in subsequent reports. The age distribution and size characteristics of walleye, northern pike, cisco and lake whitefish are presented in Tables 35 and 36, respectively. The emphasis of the following discussion is on walleye and cisco as the sample size of pike and whitefish if relatively small.

The ages of walleye ranged from 3 through 9 years with the highest numbers from the 1977 and 1978 year classes (ages 5 and 6). Similarly cisco ranged in age from 2 to 12 years with strong representation from the 1972, 1974, 1979 and 1980 year classes. Among cisco there appeared to be substantial differences in the age distribution of Snow and Slush Lakes and the remaining basins. Of the 14 fish analyzed from Snow and Slush Lakes none exceeded 5 years of age while in Icy, Abie and Marmion Lakes only 8 of 37 cisco were 5 years of age or younger.

The mean fork-length of each species at age is relatively similar to that reported in the two previous years. Among cisco, however, there appeared to be a substantial difference in fork-length and weight of cisco from Snow and Slush Lakes and those from Icy and Abie Lakes. The fork-length and weight of cisco from the latter two lakes was substantially greater than from the former two lakes. These differences are reflected in the large standard deviations associated with the fork-length and weight of 3 and 5 year old cisco. This apparent difference in growth will be analyzed to a greater extent in the summary report.

Stomach Contents

The relative frequency of occurrence of prey organisms in the stomachs of walleye, northern pike, whitefish and cisco are summarized in Table 37. The majority of the stomachs collected

TABLE 35

YEAR CLASS AND AGE DISTRIBUTION OF FISH - ATIKOKAN 1983

Year Class	81	80	79	78	77	76	75	74	73	72	71
Age	2	3	4	5	6	7	8	9	10	11	12
Walleye (n = 48)	0	2	6	14	10	5	4	7	0	0	0
Northern Pike (n = 17)	0	5	2	4	2	2	0	2	0	0	0
Cisco (n = 51)	1	9	8	6	2	1	5	7	4	7	1
Lake Whitefish (n = 4)	0	1	1	0	0	0	0	0	1	0	1

TABLE 36

MEAN FORK-LENGTH (mm) AND WEIGHT (g) OF FISH ATIKOKAN 1983

	Age										
	2	3	4	5	6	7	8	9	0	11	12
Walleye - FL	-	243>18	343>52	375>36	417>41	458>36	496>40	509>18	-	-	-
- Wt	-	140>28	403>140	550>170	778>204	1114>237	1280>353	1376>130	-	-	-
Northern Pike - FL	-	389>23	432>5	528>78	577>91	625>113	-	746>78	-	-	-
- Wt	-	459>74	517>44	1135>374	1350>566	1635>799	-	2255>1054	-	-	-
Cisco - FL	185	218>49	205>16	248>61	323>1	362	379>17	386>24	374>51	409>33	423
- Wt	77	169>169	93>38	213>284	671>105	600	829>257	886>126	826>266	982>180	950
Lake Whitefish - FL	-	275	-	312	-	-	-	-	413	-	468
- Wt	-	300	-	310	-	-	-	-	1030	-	1520

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TABLE 37

RELATIVE FREQUENCY OF OCCURRENCE OF TAXA FOUND IN THE STOMACHS OF FISH FROM ATIKOKAN - 1983

(VC - Very Common, >50%; C - Common 25 - 50%;
I - Infrequent, 10 - 25%; R - Rare <10%)

	Species			
	Walleye	Northern Pike	Lake Whitefish	Cisco
Fish	VC	VC		
Yellow Perch	C	VC		
Fish Remains (unident)	VC	I		
Cisco	I	I		
Insecta			VC	VC
Diptera			VC	C
Chironomidae			VC	C
Chironomus sp			VC	C
Procladius sp			VC	I
Potthustia sp				R
Demicryptochironomus sp				R
Chaoboridae			VC	C
Chaoborus sp			VC	C
Ephemeroptera				I
Ephemeridae				I
Hexagenia sp				I
Ephemera sp				R
Baetidae				R
Neuroptera			I	R
Sialidae			I	R
Sialis sp			I	R
Hemiptera			I	R
Corixidae			I	R
Crustacea				R
Mysidacea				R
Mysis sp				R
Acarina				R
Mollusca			C	
Sphaerium qp			C	
Plant Material				R
Cladocera				VC
Bosmina sp				VC
Copepoda			I	

from pike and walleye were empty. Those which were not empty contained fish exclusively. Yellow perch and cisco were the only species identified.

In contrast to the piscivores most of the guts of the coregonids contained prey organisms. The prey organisms of lake whitefish were indicative of a bottom feeder, and included insect larvae, (primarily dipterans), and molluscs. Cisco, however, appeared to be more varied in its feeding habits. Some cisco appeared to be exclusively planktivorous with cladocerans or copepods comprising all of the gut contents while others appeared to feed exclusively on bottom dwelling insect larvae. Fish did not occur in the stomachs of coregonids.

Creel Census

Eighteen of thirty-four replies to our questionnaire appeared to have usable information which is summarized in Table 38. Walleye was the most frequently reported species, although northern pike was probably the most frequently caught species. Several questionnaires did not list the number of pike caught. The catch per angler-day of walleye (3.2) was approximately 25% higher than that estimated for 1981 (2.5).

Figure 36 locates common fishing locations in the study area. The most frequently used areas are the culvert at North Twin Lake, the dock on Icy Lake and a few areas east of Anderson. The former two locations are frequented by shore fishermen.

Based on observations of anglers on the Marmion Lake system a conservative estimate of average effort is 15 to 25 anglers per day. Based on an average catch of 3.2 walleye and 3.0 pike per angler-day approximately 7 000 to 12 000 walleye and an equal or greater number of northern pike are harvested by anglers between May and September.

Mark-Recapture

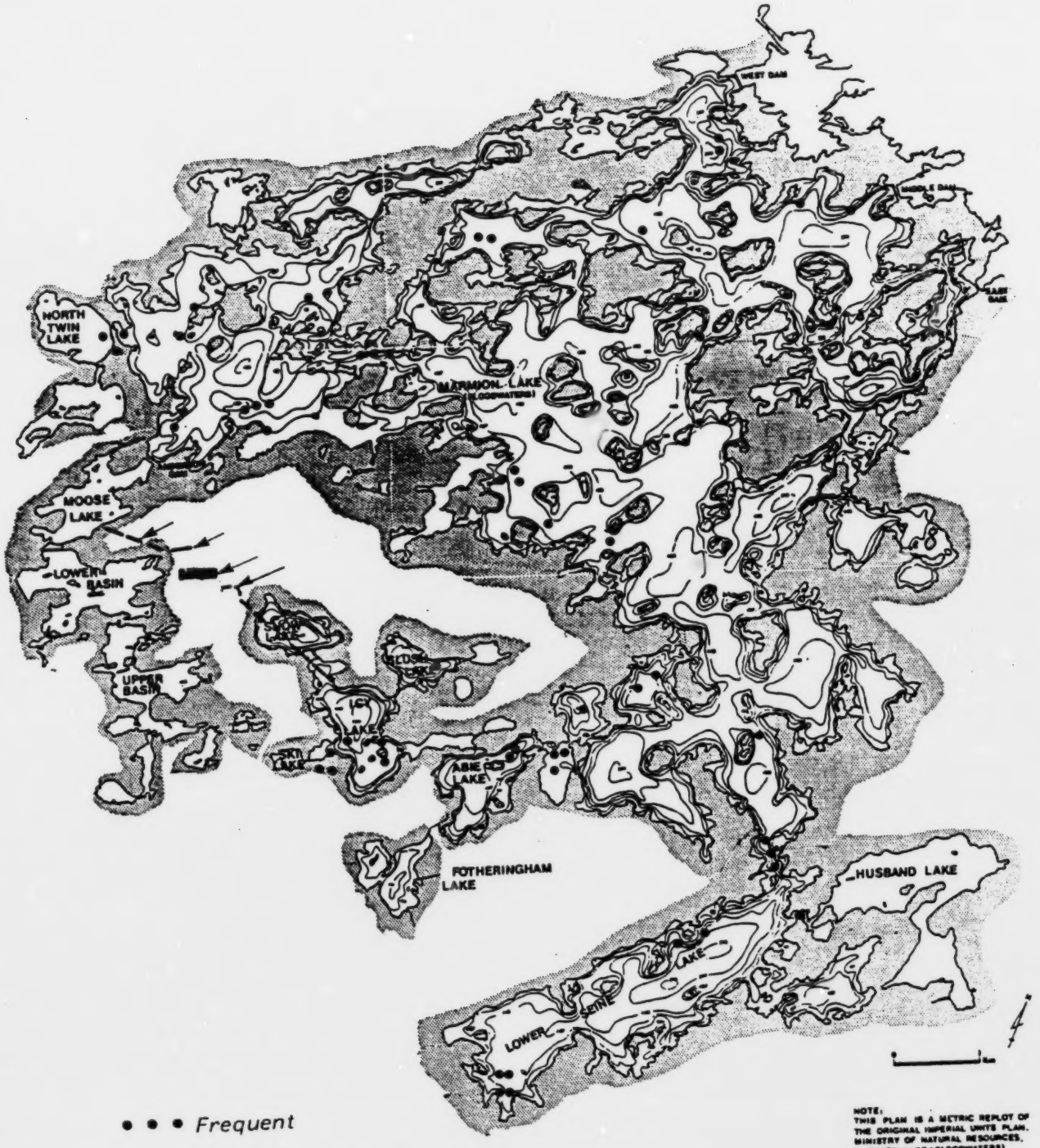
A total of 53 pike and 93 walleye were tagged during 1983 bringing the total for the 1981 to 1983 period to 301 pike and 244 walleye tagged in the study lakes (Table 39). Over the three years of study 15 marked pike and 20 walleye have been recaptured.

The recaptures reported indicate more movement of fish than previously suggested. Two northern pike tagged in Abie Lake were recovered in Marmion Lake and one pike tagged near Anderson Dam was recovered in North Twin Lake. The returns also suggest that some walleye which utilize the Spillway Dam area for spawning may move into the Seine River after spawning. In

TABLE 38

ATIKOKAN CREEL CENSUS RESULTS - 1983

Location	Average No in Party	Average Angler-days Per Party	Total Fish Catch		Catch Per Angler-Day
Marmion General n=10	4.2	9.7	Northern Pike	= 237	2.4
			Walleye	= 362	3.7
			Burbot	= 1	0.0
Lower Seine n=5	3.8	12.9	Northern Pike	= 293	4.5
			Walleye	= 215	3.3
Abie-Icy Lakes n=2	7.0	7.0	Northern Pike	= 36	2.6
			Walleye	= 24	1.7
			Lake Whitefish	= 1	0.1
Marmion Central n=1	6	24	Northern Pike	= 30	1.3
			Walleye	= 36	1.5
All Locations n=18	4.5	11.1	Northern Pike	= 596	3.0
			Walleye	= 637	3.2
			Lake Whitefish	= 1	0.0
			Burbot	= 1	0.0



• • • *Frequent*

• • *Common*

• *Occasional*

FIGURE 36

LOCATIONS WHERE ANGLERS WERE OBSERVED

TABLE 39

RECAPTURES OF TAGGED NORTHERN PIKE AND WALLEYE - ATIKOKAN 1981-1983

Basin	Year	Number Tagged		Number Recatpured[1]		Percentage Recaptured		Site of Recapture[2]	
		Pike	Walleye	Pike	Walleye	Pike	Walleye	Pike	Walleye
Snow Lake	1981	2	0	0	0	0.0	-		
	1982	17	0	0	0	0.0	-		
	1983	17	1	0	0	0.0	0.0		
Icy Lake	1981	17	5	0	0	0.0	0.0		
	1982	12	3	0	1	0.0	33.3		Icy
	1983	7	23	0	1				AB
Abie Lake	1981	26	22	4	4	15.4	18.2	AB(2) MnL(2)	AB(2) MnL(2)
	1982	4	0	0	0	0.0	-		
	1983	3	2	0	0	0.0	0.0		
Slush Lake	1981	5	0	1	0	20.0	-	SLU	
	1982	1	0	0	0	0.0	-		
Marmion Lake									
South	1981	3	2	0	1	0.0	50.0		MS
	1982	3	8	0	1	0.0	12.5		MS
	1983	1	3	0	0	0.0-	0.0		
Central	1981	6	7	0	1	0.0	14.3		LS
	1982	0	3	0	0	-	0.0		
	1983	4	5	0	0	0.0	0.0		
North[3]	1981	16	5	0	0	0.0	0.0		
	1982	2	55	0	9	0.0	16.4		SR(4) LS(2) MnL(2) MN(1)
	1983	4	51	0	1	0.0	2.0		MnL
Anderson Dam	1981	42	25	4	1	9.5	4.0	AD	AD
	1982	11	8	3	0	27.3	0.0	MnL(2) NTL(1)	
	1983	9	7	0	0	0.0	0.0		
Lower Seine	1981	10	3	0	0	0.0	0.0		
	1982	0	4	0	0	-	0.0		
	1983	3	1	0	0	0.0	0.0		
Moose Lake	1981	47	1	3	0	6.3	0.0	ML	
	1982	7	0	0	0	0.0	-		
	1983	4	0	0	0	0.0	-		
Totals	1981	186	70	12	7	6.5	86.		
	1982	62	81	3	11	4.8	13.6		
	1983	53	93	0	2	0.0	2.2		
	TOTAL	301	244	15	20	5.0	8.2		

[1] Recaptures include those captured during netting program and those returned by fishermen.

[2] Icy - Icy Lake; AB - Abie Lake; MnL - Marmion Lake; SLU - Slush Lake
MS - Marmion South; LS - Lower Seine; SR - Seine River; MN - Marmion North
AD - Anderson Dam; NTL - North Twin Lake; ML - Moose Lake

[3] Including Spillway Dam area

addition, the recapture of a walleye, tagged on spawning grounds in Icy Lake, in Abie Lake suggests that removal of the weir between Icy and Abie Lakes has allowed walleye from Marmion and Abie Lakes to move up into Icy Lake to spawn.

4.0 CONCLUSIONS

1. As in 1981 and 1982 the basins in the Atikokan cooling circuit were thermally stratified during the summer months. Oxygen depletion at depth was apparent during the time of thermal stratification and to a lesser extent during January sampling.

2. The study lakes were found to have low alkalinity with moderate levels of nutrients and ions. Levels of most of the water chemistry parameters monitored were found in higher levels in Snow, Icy and Abie Lakes than in Slush Lake and at the Marmion Lake locations. With the exception of iron, the metals monitored were most commonly found at levels close to or below their respective analytical detection levels.

3. Microbiological parameters monitored in Snow Lake into which sewage seeped during the study were unusual and indicative of a non-human source of bacterial contamination.

4. Submergent macrophyte communities were the most widespread and abundant. Substantial changes in composition and distribution of macrophytes from previous years occurred at a number of locations. Changes in Snow Lake were apparently the result of altered water levels and the input of sewage into the lake.

5. The diatoms and flagellates were the most important algal groups present in all the study lakes except Snow Lake where the blue-green algae were of equal importance as the flagellates. Estimated mean seasonal biomass was higher for Snow, Icy and Abie Lakes than for Slush Lake and Marmion Lake locations. No consistent seasonal trends were obvious in the biomass of the phytoplankton groups. Melosira was the main taxon present at most locations in the spring and/or the fall. *Cryptomonas* and an unidentified cryptophyte taxon were prominent on most sampling dates in all lakes but Snow where *Anabaena* was intermittently dominant.

6. Primary production estimates resulted in the classification of Slush Lake as oligotrophic, Marmion Lake as transitional and Icy, Abie and Snow Lakes as secondary eutrophic.

7. The species composition of the rotifers in the study lakes were quite similar with *Keratella cochlearis*, *Polyarthra* spp and *Kellicottia longispina* found to be the most abundant rotifers in all the lakes. The cyclopoid copepods were the most abundant crustacean zooplankton in all the study lakes except Snow Lake where the cladocerans were more prominent. Generally, seasonal abundance trends consistent at all locations were not observed. The spatial distributions of the rotifers and crustacean zooplankton were consistent with those of the water chemistry parameters, phytoplankton and primary production levels of the lakes, with higher densities found in Snow, Icy and Abie Lakes than in Slush and Marmion Lakes.

8. Chironomids were the primary taxon collected in insect emergence traps. Theft and vandalism of the traps, however, made the identification of spatial and seasonal trends tenuous.

9. Cyprinidae was the most abundant taxon collected in larval tows. Larval coregonids, primarily cisco, were collected in relatively large numbers probably due to cooler temperatures during the first sampling period. Walleye larvae were not collected.

10. Mimic and blacknose shiners and yellow perch were the most abundant species represented in beach seine catches. Trends in beach seine catches among locations were inconsistent. However, as reported in previous years the total catch in the upper lakes in the chain were generally higher than in Marmion Lake.

11. Cisco was the most common species caught in gill nets. The catch in gill nets was greatest at Anderson Dam and lowest in Moose Lake. The low number of fish caught in Moose Lake probably reflects a dilution effect as the lake was refilled during 1983. The low density of fish in Moose Lake will probably have an impact on fish impingement trends during the first years of station operation.

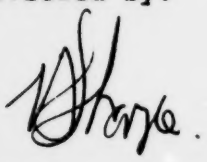
12. Ripe walleye were observed and probably spawned at the West Dam at Marmion North, Anderson Dam and at the Spillway Dam in Marmion Lake and in Icy Lake at the outflow of Ski Lake. Recapture of marked walleye suggests that walleye which utilize the spillway dam to spawn move to the Upper Seine River and that removal of the small weir between Icy and Abie Lakes has resulted in the movement of fish from Abie and probably Marmion Lakes into Icy Lake to spawn.

13. Analysis of scales of cisco suggests substantial differences in age distribution and growth of cisco from Snow and Slush lakes and those from Icy and Abie Lakes.

14. Gut content analysis of walleye, northern pike, whitefish and cisco indicated that walleye and pike feed primarily on yellow perch and cisco while whitefish are primarily bottom feeders. Some cisco appeared to be feeding primarily from the bottom while others appeared to be primarily planktivorous feeding on cladocerans and copepods.

15. Generally results from 1983 do not suggest substantial differences from previous years, however, a few differences were apparent which may have been the result of construction activities. These include effects of channelization on walleye movements, altered water levels on fish density and macrophyte distribution and seepage of sewage into Snow Lake on production and macrophyte distribution.

Reviewed by:



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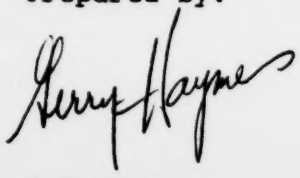

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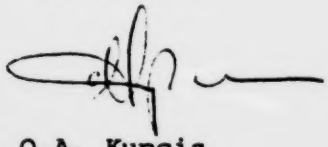

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APPENDIX 1

TEMPERATURE AND DISSOLVED OXYGEN PROFILES - ATIKOKAN 1983-84

	Temperature °C										Dissolved Oxygen (mg/L)									
					Marmion Lake										Marmion Lake					
Depth (m)	Snow Lake	Icy Lake	Abie Lake	Slush Lake	Lower Seine	South	Central	North	Anderson Dam	Moose Lake	Snow Lake	Icy Lake	Abie Lake	Slush Lake	Lower Seine	South	Central	North	Anderson Dam	Moose Lake
May 15-25																				
0	11.0	10.7	10.3	10.2	10.0	8.5	8.3	8.2	9.7	8.8	11.3	10.9	10.8	10.9	10.9	11.1	10.7	10.9	10.7	10.6
1	11.3	10.1	10.3	10.0	10.0	8.4	8.1	8.0	9.6	8.8	11.3	10.8	10.9	10.7	10.8	11.0	10.7	10.7	10.7	10.6
2	11.3	9.6	10.2	9.4	10.0	8.1	8.1	8.0	9.4	8.4	11.3	10.6	10.5	10.7	10.8	11.0	10.7	10.6	10.6	10.5
3	11.2	9.4	10.1	9.2	9.8	8.0	8.1	8.0	9.3	8.0	11.3	10.3	10.7	10.6	10.8	10.9	10.6	10.6	10.8	10.2
4	10.9	9.2	9.8	8.9	9.9	7.7	8.1	7.9	9.2	7.5	11.0	10.0	10.9	10.6	10.7	10.9	10.6	10.7	10.7	10.0
5	9.5	9.0	9.6	8.1	9.7	7.6	7.5	7.9	9.3	6.9	10.0	9.6	10.9	10.5	10.7	10.9	10.7	10.7	10.8	9.7
6	7.2	8.5	8.6	6.0	9.6	7.1	7.8	7.7	9.2	6.9	6.8	9.2	10.2	10.0	10.7	10.7	10.6	10.7	10.7	9.6
7	6.7	7.6	7.8	5.4	9.9	7.1	7.8	7.4	9.1	6.8	3.1	7.5	8.8	9.1	10.7	10.7	10.6	10.6	10.7	9.6
8	5.9	6.9	7.2	5.3	9.6	7.0	7.3	7.3	8.9	6.7	1.2	5.5	7.5	8.6	10.7	10.6	10.5	10.2	10.7	9.5
9	5.8	5.8	7.0	5.1	9.5	6.9	6.7	6.8	8.9	6.6	1.0	1.5	6.5	8.0	10.7	10.6	10.2	9.9	10.6	9.4
10		5.4	6.9	4.9	9.5	6.9	6.6	6.6	8.7	5.9		0.0	6.2	7.9	10.6	10.5	9.8	9.7	10.5	9.4
11			6.8	4.8	9.5	6.8	6.5	6.5	8.7	5.9			4.0	7.2	10.7	10.4	9.6	9.5	10.7	9.3
12				4.6	9.3	6.2	6.2	6.3		5.7				6.6	10.6	9.7	9.7	9.6		8.2
13				4.5	9.3	5.7	6.0	6.2		5.7				5.8	10.5	9.1	9.2	9.3		8.1
14				4.3	7.8	5.0	5.9	6.0		5.7				5.1	9.7	8.2	8.7	9.2		7.9
15				4.3	7.5	5.0	5.6	5.8		5.6				4.2	9.0	7.9	8.4	8.7		7.6
16					7.2	5.0	5.4	5.6		5.6					8.8	7.8	7.6	7.4		7.6
June 7-14																				
0	16.8	14.2	15.1	14.1	13.3	16.0	16.0	16.9	16.2	17.0	9.6	9.4	9.6	10.2	10.2	9.7	9.7	9.4	9.6	10.0
1	16.6	1.1	14.3	14.0	12.9	15.9	15.6	16.9	16.0	16.9	9.7	9.4	9.5	10.2	10.2	9.7	9.7	9.4	9.3	9.9
2	16.4	13.7	13.9	14.0	12.6	14.7	15.5	16.9	15.9	16.7	9.7	9.3	9.4	10.2	10.1	9.7	9.6	9.3	9.4	10.0
3	14.5	13.4	13.5	13.7	12.5	14.5	15.2	16.7	15.6	16.2	9.2	9.2	9.4	10.2	10.2	9.7	9.6	9.3	9.3	10.0
4	13.8	13.4	13.4	13.5	12.4	13.4	15.1	16.1	15.3	15.3	9.2	9.2	9.5	10.3	10.1	9.8	9.6	9.4	9.0	9.7
5	13.0	13.3	12.7	11.2	12.3	12.5	15.0	15.9	14.2	13.4	7.8	9.1	9.1	12.5	10.1	9.6	9.7	9.5	9.0	10.2
6	9.7	11.9	11.4	9.2	12.2	11.9	14.7	15.0	13.8	11.8	1.7	6.8	7.1	11.1	10.0	9.3	9.4	9.5	8.8	10.0
7	8.2	10.4	9.5	7.0	12.0	11.7	12.6	13.3	13.7	10.0	0.0	5.0	3.0	10.8	9.7	9.3	9.1	9.2	8.8	9.1
8	7.0	8.5	8.8	5.8	10.9	11.5	12.1	12.3	13.6	8.4	0.0	1.6	1.8	9.6	8.7	9.0	9.0	9.3	8.8	7.8
9	6.6	6.7	8.6	5.4	10.0	11.2	11.5	11.0	12.1	6.8	0.0	0.0	1.1	8.0	8.8	8.6	8.5	8.7	8.2	7.6
10	6.4	6.4	8.3	5.1	9.4	10.2	11.0	9.7	12.8	6.1	0.0	0.0	0.0	6.8	8.7	8.2	8.1	8.2	7.8	7.2
11				5.0	9.1	9.8	10.7	9.1		5.8				5.8	8.5	7.9	7.9	7.9		6.7
12				4.8	8.8	8.6	10.2	8.1		5.3				5.2	8.4	7.3	6.8	7.5		6.1
13				4.7	8.6	7.5	10.1	7.5		5.3				4.7	8.2	6.8	6.6	7.0		5.9
14				4.6	8.2	6.1		6.8		5.4				3.0	7.6	5.5		4.8		5.9
15				4.5	8.0	5.9		6.7		5.4				1.9	7.3	4.6		4.1		5.9
16				4.5	7.8	4.9		6.6						0.0	6.9	4.3		3.2		
July 7-9																				
0	23.4	21.4	22.2	22.8	19.5	22.1	21.0	22.1	22.7	21.4	9.5	9.2	8.8	8.3	8.7	8.7	8.7	8.6	9.0	8.5
1	23.2	21.4	21.6	22.2	19.5	22.1	20.6	22.0	22.5	21.3	9.5	8.9	8.8	8.4	8.7	8.6	8.7	8.6	8.7	8.2
2	21.1	21.3	21.4	22.2	19.5	22.0	20.4	21.9	21.8	21.2	9.5	8.8	8.8	8.4	8.7	8.5	8.8	8.6	8.6	8.1
3	19.9	21.3	20.9	21.1	19.4	20.5	20.1	21.4	20.2	20.5	9.1	8.8	8.7	8.5	8.6	8.8	8.7	8.5	8.6	7.9
4	17.9	19.7	19.0	18.8	19.3	19.1	19.3	21.4	19.3	19.5	5.0	8.4	8.3	7.8	8.6	8.7	8.6	8.7	8.2	7.4
5	14.2	18.2	15.9	14.3	19.0	18.6	18.9	21.1	18.7	16.4	0.4	7.1	6.5	11.1	8.2	8.6	8.5	8.6	7.9	7.5
6	11.6	13.2	12.8	10.8	14.7	18.1	18.6	19.4	17.9	12.4	0.0	2.7	3.5	11.5	7.3	8.3	8.4	8.5	6.8	7.2
7	9.6	11.9	11.3	8.6	13.4	15.5	18.1	18.1	17.0	10.9	0.0	0.5	0.8	10.9	7.1	7.2	8.2	7.8	6.5	6.9
8	8.2	10.2	10.3	7.3	12.6	13.6	17.1	14.7	14.7	9.4	0.0	0.0	0.0	9.2	6.8	6.2	7.7	7.1	2.9	5.6
9	7.9	8.5	9.8	6.2	11.7	13.0	14.9	12.8	13.1	7.3	0.0	0.0	0.0	6.4	6.7	6.1	6.8	7.0	1.3	5.2
10	7.7	8.0	9.5	5.9	10.7	12.1	13.6	11.3	13.1	6.3	0.0	0.0	0.0	5.6	6.4	5.7	6.3	6.6	1.3	5.0
11			9.3	5.5	9.8	10.6	13.1	10.0		5.7			0.0	3.9	6.2	5.0	6.1	6.1		4.8
12				5.4	9.3	9.2	12.6	8.5		5.3				2.9	5.7	5.2	5.6	5.1		4.3
13				5.1	9.3	8.1	12.4	8.0		5.3				0.7	5.7	5.1	5.2	4.0		4.0
14				5.0	9.3	7.0	11.9	7.0		5.4				0.4	5.6	3.1	4.1	1.5		3.8
15				4.9	9.0	6.7		6.8		5.4				0.4	5.5	2.6		0.0		3.8
16				4.9	8.8	6.6		6.5		5.4				0.2	5.0	2.4		0.0		3.8
Aug 3-5																				
0	23.6	25.4	24.4	25.6	24.5	24.0	24.0	23.9	23.4	24.9	8.3	8.4	8.3	8.1	8.4	9.8	8.6	8.1	8.3	7.9
1	23.5	25.3	24.4	25.0	24.4	23.9	23.6	23.5	23.2	24.8	8.2	8.3	8.3	8.1	8.4	8.5	8.4	8.1	8.2	7.9
2	23.5	24.4	24.1	24.1	24.4	23.3	23.3	23.4	23.0	24.6	8.2	8.2	8.2	8.2	8.4	8.4	8.3	8.1	8.2	7.9
3	23.1	23.7	23.5	23.3	24.3	23.1	23.2	23.2	22.8	23.5	7.7	8.2	8.2	8.2	8.4	8.2	8.4	8.1	8.0	7.3
4	21.8	22.6	23.0	21.4	23.5	22.9	23.1	23.1	22.7	21.7	2.1	7.5	8.1	9.3	8.1	8.2	8.3	8.1	7.9	5.8
5	17.5	18.6	21.4	16.9	23.1	22.6	22.8	22.9	22.0	17.0	0.0	4.4	7.2	11.3	7.9	8.0	8.1	7.5	6.8	3.5
6	13.7	15.4	15.7	12.8	20.9	21.0	21.4	20.9	18.7	13.1	0.0	0.0	3.7	11.9	6.8	7.2	7.1	6.3	1.6	3.3
7	10.6	13.4	13.8	9.2	18.4	17.5	17.9	18.2	15.7	10.2	0.0	0.0	0.9	10.7	5.5	5.2	5.3	5.3	0.0	3.0
8	8.9	10.9	12.1	7.7	14.2	1.3	15.6	16.0	14.7	7.7	0.0	0.0	0.5	8.5	4.2	3.7	4.4	5.0	0.0	3.4
9	8.3	9.7	11.2	6.6	12.2	13.9	14.4	14.0	13.1	6.7	0.0	0.0	0.0	7.2	4.5	3.0	3.7	5.0	0.0	3.6
10	7.8	8.6	9.7	6.1	11.1	11.9	13.7	11.6	13.0	5.9	0.0	0.0	0.0	4.3	4.5	3.0	3.3	4.4	0.0	3.5
11				5.7	10.2	10.4	12.6	10.2	13.0	5.5				2.2	4.6	2.2	2.3	3.8	0.0	3.0
12				5.3	9.2	9.5	12.2	8.0		5.5				0.2	4.0	3.0	1.2	2.2		2.8
13				5.2	8.8	8.7	12.3	8.0		5.6				0.0	3.1	2.5	1.1	2.2		2.6
14				5.0	8.6	7.2	12.5	7.5		5.7				0.0	2.0	0.7	1.1	0.0		2.9
15				4.9	8.4					5.8				0.0	1.5					2.6
16				4.7	8.2					5.7				0.0	0.0					2.5

APPENDIX 1 (cont'd)

TEMPERATURE AND DISSOLVED OXYGEN PROFILES - ATIKOKAN 1983-84

Depth (m)	Temperature °C										Dissolved Oxygen (mg/L)									
	Snow Lake	Icy Lake	Abie Lake	Slush Lake	Marmion Lake					Moose Lake	Snow Lake	Icy Lake	Abie Lake	Slush Lake	Marmion Lake					Moose Lake
					Lower Seine	South	Central	North	Anderson Dam						Lower Seine	South	Central	North	Anderson Dam	
Sept 1-2																				
0	22.9	24.3	24.6	24.0	23.3	23.2	23.5	22.8	23.3	23.1	9.4	8.3	8.5	8.2	8.6	8.8	8.6	8.2	8.1	7.9
1	22.7	24.2	24.2	23.7	23.3	23.1	23.2	22.6	22.4	22.5	9.4	8.3	8.1	8.3	8.6	8.6	8.6	8.3	8.1	8.0
2	22.6	23.6	23.6	23.2	23.3	23.0	22.8	22.4	22.3	22.4	9.3	8.1	8.2	8.3	8.6	8.8	8.6	8.3	8.1	7.9
3	22.2	22.9	22.9	22.5	23.3	22.8	22.8	22.3	22.2	22.3	8.2	8.1	7.9	8.7	8.6	8.7	8.6	8.2	7.9	7.9
4	21.7	21.5	21.5	19.1	22.7	22.6	22.7	22.3	22.2	22.0	6.2	7.6	6.8	11.1	8.4	8.2	8.6	8.2	7.9	5.9
5	19.6	18.9	18.9	17.0	22.5	22.3	22.5	22.2	21.7	16.7	1.6	4.1	2.6	12.0	7.7	8.1	8.6	8.1	6.2	2.4
6	13.4	15.5	15.5	12.9	21.6	21.4	22.4	21.7	20.4	13.6	0.0	0.0	0.1	12.1	6.5	6.4	8.0	5.5	3.8	1.1
7	10.9	13.5	13.5	10.5	20.7	19.2	20.8	20.6	18.4	9.9	0.0	0.0	0.0	11.0	4.9	3.4	6.0	3.9	0.6	0.9
8	9.1	11.0	11.0	7.8	18.3	17.3	17.3	17.2	15.0	8.5	0.0	0.0	0.0	7.6	3.1	2.8	1.8	2.3	0.0	1.5
9	8.6	9.7	9.7	7.0	12.8	16.3	15.4	14.0	13.2	7.3	0.0	0.0	0.0	5.0	2.8	1.8	1.1	2.3	0.0	1.9
10	8.4	8.5	8.5	6.5	11.0	13.4	14.5	11.8	13.0	6.5	0.0	0.0	0.0	3.0	2.9	0.8	0.7	2.2	0.0	2.4
11				6.1	10.3	11.4	13.3	10.9	13.0	5.8			0.0	1.2	2.9	1.2	0.2	1.6	0.0	2.1
12				5.6	9.6	10.3	13.0	9.4		5.6				0.0	2.7	1.2	0.0	1.0		1.9
13				5.4	9.3	9.0	13.1	8.4		5.5				0.0	1.8	0.6	0.0	0.0		1.7
14				5.0	8.8	7.8	13.0	7.6		5.7				0.0	1.5	0.2	0.0	0.0		1.7
15				4.9	8.7	7.8	12.8	7.4		5.6				0.0	0.6	0.2	0.0	0.0		1.6
16				4.8	8.4			6.8		5.7				0.0	0.3			0.0		1.4
Sept 21-24																				
0	13.0	13.6	13.5	13.7	13.5	14.6	13.6	14.6	13.6	13.1	9.2	7.9	8.7	9.7	10.0	8.7	9.1		6.7	8.8
1	13.0	13.6	13.6	13.7	13.6	14.8	13.6	14.6	13.8	13.0	9.0	7.9	8.3	9.6	9.0	8.2	8.9		8.8	8.6
2	13.0	13.6	13.6	13.7	13.6	14.8	13.6	14.6	13.8	13.0	8.9	7.9	7.8	9.5	8.7	7.9	8.9		8.4	8.6
3	13.0	13.6	13.6	13.7	13.6	14.8	13.6	14.6	13.8	13.0	8.7	7.9	7.8	9.5	8.7	7.1	8.9		8.7	8.5
4	13.0	13.6	13.6	13.7	13.7	14.8	13.6	14.6	13.8	13.0	8.8	7.8	7.7	9.5	8.7	7.9	8.8		8.5	8.5
5	13.0	13.6	13.6	13.7	13.6	14.8	13.6	14.6	13.8	13.0	8.7	7.8	7.6	9.4	8.6	7.9	8.8		8.6	8.4
6	13.1	13.6	13.6	13.7	13.7	14.8	13.6	14.7	13.8	13.0	8.7	7.8	7.6	9.4	8.6	7.9	8.7		8.5	8.4
7	13.0	13.6	13.4	13.7	13.6	14.8	13.6	14.6	1.8	13.0	8.7	7.9	7.6	9.4	8.6	7.8	8.7		8.5	8.4
8	12.1	13.6	12.3	9.1	13.7	14.8	13.6	14.6	13.8	9.9	1.4	7.7	0.9	8.0	8.7	7.8	8.7		8.6	4.2
9	8.5	9.9	10.4	7.8	13.6	14.7	13.5	14.6	13.8	8.8	0.0	0.0	0.0	4.8	8.6	7.8	8.7		8.4	0.5
10	8.1	9.2	10.3	6.7	13.6	14.6	13.5	14.6	13.8	8.0	0.0	0.0	0.0	2.2	8.7	7.4	8.8		8.4	0.8
11			10.1	6.3	9.8	14.1	13.5	14.7		7.4			0.2	2.3	1.5	6.9	8.4			0.7
12				6.2	9.5	10.4	13.5	10.1		6.6				0.0	0.9	0.3	8.6			1.0
13				5.5	9.0	9.0	13.5	8.5		6.2				0.0	0.8	0.0	8.5			1.1
14				5.2	8.9	8.1	13.5	7.7		5.9				0.0	0.0	0.0	8.4			1.2
15				4.8	8.5	7.9	13.5	7.1		5.8				0.0	0.0	0.0	8.4			1.2
16				4.7	8.4	7.8		6.9						0.0	0.0	0.0				
Oct 24																				
0	6.6	6.4	6.7	7.4		7.3		7.2	6.4			10.4	10.7							
1	6.6	6.6	6.6	7.3		7.5		7.2	6.4			10.4	10.7							
2	6.6	6.4	6.6	7.3		7.6		7.2	6.4			10.3	10.8							
3	6.6	6.4	6.6	7.4		7.6		7.2	6.4			10.3	10.5							
4	6.6	6.4	6.7	7.3		7.6		7.2	6.4			10.2	10.6							
5	6.6	6.4	6.6	7.3		7.8		7.2	6.4			10.0	10.5							
6	6.6	6.4	6.7	7.3		7.8		7.2	6.4			10.1	10.7							
7	6.5	6.6	6.7	7.3		7.8		7.2	6.4			10.1	10.6							
8	6.5	6.6	6.7	7.3		7.8		7.2	6.4			10.0	10.6							
9	6.5	6.6	6.7	7.2		7.8		7.2	6.4			10.0	10.6							
10	6.5		6.7	7.1		7.8		7.2	6.4				10.3							
11			6.5	7.0		6.8		7.2	6.4				10.0							
12				7.0		6.8		7.2	6.4											
13				6.1		7.8		7.2												
14				5.1		7.8		7.2												
15				4.7		7.8		7.1												
16				4.6		7.8		7.1												
Jan 23-24																				
0	0.1	0.1	0.2	0.2	0.2	0.1	0.3	0.5	0.3	0.1	11.2	12.1	11.1	12.0	13.1	14.0	13.7	13.5	14.7	14.7
1	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.3	0.2	0.0	10.2	11.3	9.0	13.0	13.7	13.0	1.1	13.1	14.4	14.0
2	0.4	0.3	0.3	0.9	0.2	0.1	0.2	0.2	0.1	0.0	9.9	11.0	8.8	12.7	12.7	13.5	15.9	13.2	14.0	14.0
3	0.4	0.4	0.4	1.1	0.3	0.2	0.1	0.0	0.3	0.6	9.6	10.3	8.4	12.2	10.7	13.9	15.6	13.0	13.9	13.0
4	1.0	0.5	0.6	1.1	0.6	0.2	0.4	0.1	0.4	0.9	9.4	10.0	8.3	11.5	9.8	14.6	16.6	12.8	13.0	11.7
5	1.1	0.5	0.7	1.3	0.6	0.3	0.5	0.3	1.4	1.1	8.2	9.5	7.8	11.2	8.8	14.9	13.1	12.5	11.8	11.3
6	1.2	0.9	1.1	1.4	0.8	0.4	0.7	0.5	1.8	1.3	8.0	9.2	7.8	10.5	8.7	14.2	13.9	11.7	11.6	13.1
7	1.3	1.1	1.4	1.6	0.8	0.7	0.7	0.7	1.8	1.5	7.5	7.6	6.6	10.3	8.1	14.3	12.0	11.4	11.6	12.4
8	1.7	1.2	2.0	1.6	1.0	0.8	0.9	0.8	2.1	1.5	6.9	7.3	6.3	10.1	7.8	13.0	11.7	11.1		12.4
9	1.9	1.2	2.3	1.8	1.1	1.0	1.1	1.1	2.2	1.6	2.8	4.0	5.0	9.8	7.2	12.9	10.0	10.7		12.4
10	2.5		2.3	1.8	1.2	1.0	1.1	1.3		1.8	2.2		3.7	9.3	7.0	12.2	9.9	10.2		12.1
11			2.4	2.2	1.2	1.2	1.2	1.6		1.9			1.9	9.1	7.1	12.0	7.4	10.2		13.4
12				2.2	1.3	1.3	1.2	1.9		2.1				7.8	6.8	11.3	5.3	9.1		12.5
13				2.4	1.5	1.9		2.1		2.2				7.5	6.6	9.2		8.6		12.6
14				2.4	1.4	2.1		2.2						3.6	4.2	8.8		7.2		
15				2.4		2.2		2.7						1.2		6.1		6.6		
16						2.3		2.7								5.3		5.6		

APPENDIX 2

WATER CHEMISTRY - SNOW LAKE
MAY, AUGUST, OCTOBER 1983 AND JANUARY 1984

Parameter	May		August		October		January	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
Turbidity (NTU)	1.5	1.2	1.7	1.0	0.6	0.6	0.6	1.0
Specific Conductance (mS/m)	11.0	11.0	12.5	12.5	13.2	13.3	15.0	16.5
pH (at 25°C)	6.7	7.1	6.7	78	7.3	7.3	7.1	7.0
Total Hardness ($CaCO_3$, mg/L)	45	45	53	54	58	57	65.5	70.6
Alkalinity (HCO_3 as $CaCO_3$, mg/L)	44		47		49		52	
Filtrable Residues 105°C (mg/L)	78	78	66	56	98	94	96	106
550°C (mg/L)	76	20	22	28	50	70	64	68
Non-Filtrable Residues 105°C (mg/L)	1	2	2	1	2	<2	<2	<2
550°C (mg/L)	<1	1	1	<1	<2	<2	<2	<2
Total Silica (mg SiO_2/L)	2.9	2.0	0.6	1.4	1.3	1.68	2.57	2.43
Soluble Silica (mg SiO_2/L)	2.6	1.5	0.4	1.0	1.3	1.52	2.0	1.95
Total Phosphorus (mg P/L)	X	0.013	0.045	0.016	0.019	0.022	0.018	0.018
Soluble Phosphorus (mg P/L)	0.005	0.004	0.005	0.003	0.004	0.004	0.005	<0.005
Total Kjeldahl Nitrogen (mg N/L)	0.46	0.52	0.35	0.41	0.80	0.51	0.60	0.56
Nitrate (mg NO_3/L)	<0.01	<0.01	0.12	0.53	<0.01	<0.01	0.75	1.16
Total Organic Carbon (mg/L)	9	8	10	10	12	13	13	14
Total Inorganic Carbon (mg/L)	11	11	12	11	11	11	11	12
Sulphate (mg SO_4/L)	5.9	6.6	6.1	6.0	6.8	7.5	7.6	8.4
Chloride (mg/L)	3.2	3.1	3.7	4.8	5.2	5.8	7.3	7.9
Ammonia (mg NH_3/L)	<0.01	<0.01	0.02	0.01	0.03	0.08	0.11	0.11
Calcium (mg/L)	14.7	14.6	16.9	16.8	19	18	21.3	23.0
Magnesium (mg/L)	2.1	2.1	2.5	2.4	2.6	2.6	3.0	3.2
Sodium (mg/L)	2.3	2.2	2.8	2.5	3.0	3.0	3.75	3.84
Potassium (mg/L)	0.92	0.92	0.98	0.93	1.11	1.11	1.37	1.37
Filtrable Iron (mg/L)	0.104	0.05	0.047	0.095	0.098	0.073	0.022	0.019
Total Iron (mg/L)	0.07	<0.05	0.05	0.10	0.07	0.08	<0.05	<0.015
Nickel (mg/L)	0.008	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Aluminum (mg/L)	<0.5	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5
Copper (mg/L)	0.003	0.001	0.002	0.003	<0.001	0.002	<0.001	<0.001
Zinc (mg/L)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Manganese (mg/L)	<0.05	<0.05	<0.05	0.85	0.08	0.15	<0.05	0.06
Mercury (filtered, mg/L)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Arsenic (mg/L)	<0.001	<0.001	0.001	0.003	0.002	0.002	<0.001	<0.001
Selenium (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

X Sample contaminated

APPENDIX 2 cont'd

WATER CHEMISTRY - ICY LAKE
MAY, AUGUST, OCTOBER 1983 AND JANUARY 1984

Parameter	May		August		October		January	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
Turbidity (NTU)	1.0	1.4	0.6	1.0	0.3	0.5	1.2	0.5
Specific Conductance (mS/m)	15.0	16.0	14.6	17.7	15.6	23.3	17.6	16.4
pH (at 25°C)	7.5	7.4	8.0	7.0	7.5	7.4	7.4	7.2
Total Hardness ($CaCO_3$, mg/L)	64	64	56	76	68	66	73	70
Alkalinity (HCO_3 as $CaCO_3$, mg/L)	66		66		61		63	
Filtrable Residues 105°C (mg/L)	110	112	96	112	98	94	102	96
550°C (mg/L)	50	70	34	54	64	44	78	62
Non-Filtrable Residues 105°C (mg/L)	2	1	1	2	<2	<2	<2	<2
550°C (mg/L)	2	<1	<1	1	<2	<2	<2	<2
Total Silica (mg SiO_2/L)	5.0	5.6	2.4	6.8	4.C	4.2	5.2	4.9
Soluble Silica (mg SiO_2/L)	5.0	5.6	2.4	6.6	4.0	4.2	5.2	4.8
Total Phosphorus (mg P/L)	0.006	<0.005	0.012	0.032	0.027	0.017	0.018	0.011
Soluble Phosphorus (mg P/L)	0.005	0.004	0.003	0.005	0.011	0.009	0.006	<0.005
Total Kjeldahl Nitrogen (mg N/L)	0.55	0.48	0.39	0.61	0.47	0.42	0.58	0.44
Nitrate (mg NO_3/L)	<0.01	<0.01	0.07	0.02	0.03	0.02	0.23	0.35
Total Organic Carbon (mg/L)	4	5	12	13	11	11	13	13
Total Inorganic Carbon (mg/L)	20	20	13	16	14	15	17	14
Sulphate (mg SO_4/L)	5.3	3.8	4.0	4.1	4.4	5.1	5.1	4.6
Chloride (mg/L)	7.3	5.5	7.1	7.3	8.2	8.2	9.3	9.00
Ammonia (mg NH_3/L)	<0.01	<0.01	0.02	0.03	0.02	0.061	0.08	0.06
Calcium (mg/L)	20.0	20.0	16.9	22.3	21	20.0	22.6	21.6
Magnesium (mg/L)	3.5	3.5	3.4	4.0	3.9	4.0	4.1	3.9
Sodium (mg/L)	4.0	4.2	4.3	4.5	4.6	4.6	5.4	5.0
Potassium (mg/L)	1.00	1.0	0.74	1.01	0.94	0.96	1.16	1.06
Filtrable Iron (mg/L)	0.056	0.104	0.033	0.120	0.101	0.109	0.032	0.022
Total Iron (mg/L)	<0.05	<0.05	<0.05	0.10	<0.05	0.05	<0.05	<0.05
Nickel (mg/L)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Aluminum (mg/L)	<0.5	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.05
Copper (mg/L)	0.001	0.001	0.001	0.002	0.001	0.001	<0.001	<0.001
Zinc (mg/L)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	<0.02
Manganese (mg/L)	0.10	0.23	<0.05	2.14	<0.05	0.90	<0.05	0.08
Mercury (filtered, mg/L)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Arsenic (mg/L)	<0.001	<0.001	<0.001	0.003	0.002	0.002	<0.001	<0.001
Selenium (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

- Sample damaged in transit
X Sample contaminated

APPENDIX 2 cont'd

WATER CHEMISTRY - ABIE LAKE
MAY, AUGUST, OCTOBER 1983 AND JANUARY 1984

Parameter	May		August		October		January	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
Turbidity (NTU)	1.1	1.3	-	1.0	0.4	0.4	0.5	0.4
Specific Conductance (mS/m)	13.0	13.0	-	13.0	13.0	13.0	15.1	14.5
pH (at 25°C)	7.5	7.2	-	7.0	7.4	7.4	7.2	7.2
Total Hardness ($CaCO_3$, mg/L)	53	51	54	57	57	57	65	61
Alkalinity (HCO_3 as $CaCO_3$, mg/L)	53		53		52		-	
Filtrable Residues 105°C (mg/L)	92	96	-	8.6	88	88	98	90
550°C (mg/L)	22	30	-	60	50	58	64	56
Non-Filtrable Residues 105°C (mg/L)	<1	2	-	1	<2	<2	<2	<2
550°C (mg/L)	<1	<1	-	<1	<2	<2	<2	<2
Total Silica (mg SiO_2/L)	3.8	4.4	2.0	2.9	2.5	2.8	4.4	4.5
Soluble Silica (mg SiO_2/L)	3.4	3.3	2.0	2.9	2.5	2.70	3.7	3.7
Total Phosphorus (mg P/L)	<0.005	X	-	0.021	0.016	0.011	0.015	0.013
Soluble Phosphorus (mg P/L)	<0.002	0.002	-	0.004	0.004	0.003	<0.005	<0.0005
Total Kjeldahl Nitrogen (mg N/L)	0.45	0.48	0.39	0.36	0.41	0.44	0.51	0.44
Nitrate (mg NO_3/L)	<0.01	<0.01	0.58	0.02	<0.01	0.04	0.18	0.71
Total Organic Carbon (mg/L)	8	8	-	10	13	12	14	12
Total Inorganic Carbon (mg/L)	13	12	-	14	12	12	11	12
Sulphate (mg SO_4/L)	4.9	4.9	-	4.2	4.7	4.5	4.9	4.7
Chloride (mg/L)	4.1	4.1	-	4.6	5.1	5.0	8.9	8.2
Ammonia (mg NH_3/L)	<0.01	<0.01	<0.01	0.02	0.02	0.04	0.08	0.08
Calcium (mg/L)	16.3	15.7	16.5	17.0	17.0	17.0	19.9	18.6
Magnesium (mg/L)	3.0	2.9	3.2	3.3	3.3	3.3	3.9	3.6
Sodium (mg/L)	3.2	3.1	3.5	3.3	3.5	3.6	4.6	4.2
Potassium (mg/L)	0.89	0.88	0.84	0.87	0.83	0.84	1.15	0.92
Filtrable Iron (mg/L)	0.040	0.070	0.039	0.056	0.062	0.086	0.024	0.102
Total Iron (mg/L)	<0.05	0.06	<0.05	0.10	<0.05	0.09	0.05	<0.05
Nickel (mg/L)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Aluminum (mg/L)	<0.5	<0.5	<1	<0.1	<0.5	<0.5	<0.5	<0.5
Copper (mg/L)	0.001	0.001	0.002	0.002	0.001	0.001	<0.001	<0.001
Zinc (mg/L)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Manganese (mg/L)	0.05	0.08	<0.05	0.32	0.08	<0.14	<0.05	<0.05
Mercury (filtered, mg/L)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Arsenic (mg/L)	<0.001	<0.001	0.001	0.002	0.001	0.001	<0.001	<0.001
Selenium (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

- No data, sample destroyed in transit
X Sample contaminated

APPENDIX 2 cont'd

WATER CHEMISTRY - SLUSH LAKE
MAY, AUGUST, OCTOBER 1983 AND JANUARY 1984

Parameter	May		August		October		January	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
Turbidity (NTU)	1.4	1.6	1.7	2.3	0.6	0.8	1.0	1.6
Specific Conductance (mS/m)	5.1	5.3	5.1	5.9	5.2	5.5	7.3	5.5
pH (at 25°C)	7.1	6.6	7.2	7.2	7.3	6.6	7.0	6.9
Total Hardness ($CaCO_3$, mg/L)	21	22	22	27	24	24	26	24
Alkalinity (HCO_3 as $CaCO_3$, mg/L)	24		23		24		9	
Filtrable Residues 105°C (mg/L)	50	50	28	50	46	40	54	44
550°C (mg/L)	4	<1	2	26	24	32	36	14
Non-Filtrable Residues 105°C (mg/L)	2	3	1	7	<2	<2	2	<2
550°C (mg/L)	<1	<1	<1	2	<2	<2	<2	<2
Total Silica (mg SiO_2/L)	1.9	2.6	1.2	3.0	1.2	2.2	2.1	1.9
Soluble Silica (mg SiO_2/L)	1.6	2.5	1.2	2.8	1.2	2.1	2.0	1.9
Total Phosphorus (mg P/L)	X	0.007	0.011	0.053	0.006	0.019	0.014	0.008
Soluble Phosphorus (mg P/L)	<0.002	<0.002	<0.002	0.007	<0.002	0.002	<0.005	<0.005
Total Kjeldahl Nitrogen (mg N/L)	0.35	0.38	0.29	0.43	0.29	0.31	0.47	0.34
Nitrate (mg NO_3/L)	<0.01	<0.01	0.01	0.88	0.02	<0.01	0.11	0.04
Total Organic Carbon (mg/L)	6	7	9	9	8	11	10	8
Total Inorganic Carbon (mg/L)	7	7	6	7	5	6	6	5
Sulphate (mg SO_4/L)	2.4	2.0	2.2	1.7	2.3	2.3	2.8	2.2
Chloride (mg/L)	0.4	0.3	0.2	0.5	0.6	0.4	2.7	1.4
Ammonia (mg NH_3/L)	0.01	0.02	<0.01	0.02	<0.01	<0.01	0.03	0.04
Calcium (mg/L)	7.0	7.3	7.3	8.3	7.9	8.0	8.5	7.8
Magnesium (mg/L)	0.92	0.98	0.95	1.06	0.93	0.98	1.2	1.15
Sodium (mg/L)	0.61	0.64	0.64	0.67	0.80	0.80	0.77	0.66
Potassium (mg/L)	0.37	0.37	0.37	0.45	0.38	0.44	0.48	0.40
Filtrable Iron (mg/L)	0.036	0.19	0.040	0.130	0.032	0.070	0.075	0.59
Total Iron (mg/L)	0.05	0.23	<0.05	0.34	<0.05	0.08	<0.05	0.05
Nickel (mg/L)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.005	<0.005
Aluminum (mg/L)	<0.5	<0.05	<1	<1	<0.5	<0.5	<0.5	<0.5
Copper (mg/L)	<0.001	0.002	0.002	0.002	<0.001	<0.091	<0.001	<0.001
Zinc (mg/L)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Manganese (mg/L)	<0.05	0.13	<0.05	0.90	<0.05	0.15	<0.05	<0.05
Mercury (filtered, mg/L)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Arsenic (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

X Sample contaminated

APPENDIX 2 cont'd

WATER CHEMISTRY - MARMION SOUTH
MAY, AUGUST, OCTOBER 1983 AND JANUARY 1984

Parameter	May		August		October		January	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
Turbidity (NTU)	1.0	1.3	0.5	0.7	0.3	0.5	0.5	1.0
Specific Conductance (mS/m)	9.1	9.0	9.1	9.4	9.6	9.4	11.0	10.5
pH (at 25°C)	7.3	7.3	7.7	7.1	7.3	7.2	7.2	7.0
Total Hardness ($CaCO_3$, mg/L)	38	39	38	38	41	41	43	40
Alkalinity (HCO_3 as $CaCO_3$, mg/L)	37		34		35		34	
Filtrable Residues 105°C (mg/L)	74	70	68	66	52	58	64	64
550°C (mg/L)	26	24	20	26	22	34	36	28
Non-Filtrable Residues 105°C (mg/L)	<1	<1	1	2	<2	<2	<2	<2
550°C (mg/L)	<1	<1	<1	1	<2	<2	<2	<2
Total Silica (mg SiO_2/L)	3.0	3.0	1.8	3.5	2.5	3.4	2.6	2.6
Soluble Silica (mg SiO_2/L)	2.8	2.8	1.7	3.2	2.4	2.8	2.5	2.5
Total Phosphorus (mg P/L)	<0.005	<0.005	0.014	0.021	0.013	0.017	0.015	0.014
Soluble Phosphorus (mg P/L)	0.003	0.002	<0,002	0.004	0.005	0.005	<0.005	<0.005
Total Kjeldahl Nitrogen (mg N/L)	0.31	0.33	0.25	0.25	0.32	0.31	0.40	0.33
Nitrate (mg NO_3/L)	<0.01	<0.01	0.14	0.02	0.01	0.06	0.14	<0.01
Total Organic Carbon (mg/L)	6	6	9	8	9	9	11	10
Total Inorganic Carbon (mg/L)	11	11	8	9	8	8	9	7
Sulphate (mg SO_4/L)	6.3	7.9	7.0	7.0	7.7	8.4	8.3	8.2
Chloride (mg/L)	1.6	1.7	1.5	1.5	1.6	2.4	3.6	4.9
Ammonia (mg NH_3/L)	<0.01	<0.01	0.01	0.01	<0.01	0.02	0.03	0.03
Calcium (mg/L)	11.0	11.0	10.6	10.6	11.0	11.0	12.4	11.5
Magnesium (mg/L)	2.6	2.7	2.8	2.9	3.0	3.0	3.0	2.8
Sodium (mg/L)	1.9	1.9	2.0	2.0	2.0	2.0	2.3	2.2
Potassium (mg/L)	0.71	0.68	0.68	0.71	0.73	0.73	0.81	0.75
Filtrable Iron (mg/L)	0.040	0.049	0.039	0.054	0.038	0.120	0.016	0.017
Total Iron (mg/L)	<0.05	<0.05	<0.05	<0.05	0.05	0.06	<0.05	<0.05
Nickel (mg/L)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Aluminum (mg/L)	<0.5	<0.5	<1.0	<1	<0.5	<0.5	<0.5	<0.05
Copper (mg/L)	0.001	0.001	0.002	0.002	0.001	0.001	<0.001	<0.001
Zinc (mg/L)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Manganese (mg/L)	0.10	0.13	<0.05	<0.09	0.14	0.09	<0.05	<0.05
Mercury (filtered, mg/L)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Arsenic (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

APPENDIX 2 cont'd

WATER CHEMISTRY - MARMION NORTH
MAY, AUGUST, OCTOBER 1983 AND JANUARY 1984

Parameter	May		August		October		January	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
Turbidity (NTU)	1.2	1.2	0.4	0.5	0.4	0.4	1.0	0.7
Specific Conductance (mS/m)	8.8	8.8	9.4	9.2	9.3	11.0	10.6	9.8
pH (at 25°C)	7.3	7.1	7.5	6.7	7.3	7.0	7.0	7.2
Total Hardness ($CaCO_3$, mg/L)	36	36	37	38	40	40	42	41
Alkalinity (HCO_3 as $CaCO_3$, mg/L)	35		33		33		35	
Filtrable Residues 105°C (mg/L)	62	56	63	50	56	60	71	76
550°C (mg/L)	28	32	19	4	32	28	44	24
Non-Filtrable Residues 105°C (mg/L)	<1	1	<1	<1	<2	<2	<2	<2
550°C (mg/L)	<1	<1	<1	<1	<2	<2	<2	<2
Total Silica (mg SiO_2/L)	3.0	3.4	1.8	3.1	2.8	2.9	2.8	2.7
Soluble Silica (mg SiO_2/L)	2.8	3.0	1.7	3.0	2.4	2.9	2.7	2.6
Total Phosphorus (mg P/L)	<0.005	<0.005	0.018	0.016	0.010	0.011	0.016	0.014
Soluble Phosphorus (mg P/L)	<0.002	<0.002	<0.002	0.003	0.004	0.005	0.005	<0.003
Total Kjeldahl Nitrogen (mg N/L)	0.36	0.36	0.34	0.25	0.29	0.29	0.49	0.32
Nitrate (mg NO_3/L)	<0.01	<0.01	1.38	0.04	0.03	0.04	0.02	<0.01
Total Organic Carbon (mg/L)	7	5	7	9	9	9	8	7
Total Inorganic Carbon (mg/L)	9	10	9	8	8	8	11	10
Sulphate (mg SO_4/L)	7.4	8.3	7.1	7.7	8.0	8.8	8.8	8.0
Chloride (mg/L)	1.4	1.8	1.8	1.4	1.4	2.0	3.9	2.5
Ammonia (mg NH_3/L)	<0.01	<0.01	0.01	<0.01	0.01	0.02	0.04	0.04
Calcium (mg/L)	10.0	10.0	10.3	10.6	11.0	11.0	11.8	11.5
Magnesium (mg/L)	2.7	2.7	2.8	2.9	2.9	2.9	3.1	3.0
Sodium (mg/L)	1.8	1.9	2.0	2.0	2.0	2.0	2.3	2.2
Potassium (mg/L)	0.72	0.72	0.68	0.70	0.72	0.70	0.90	0.74
Filtrable Iron (mg/L)	0.044	0.078	0.040	0.047	0.086	0.134	0.022	0.017
Total Iron (mg/L)	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel (mg/L)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Aluminum (mg/L)	<0.05	<0.5	<1	<1	<0.5	<0.5	<0.05	<0.05
Copper (mg/L)	0.001	0.001	0.002	0.002	0.001	0.001	<0.001	<0.001
Zinc (mg/L)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	<0.02
Manganese (mg/L)	0.07	0.09	<0.05	0.06	<0.05	<0.05	<0.05	<0.05
Mercury (filtered, mg/L)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Arsenic (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

APPENDIX 2 cont'd

WATER CHEMISTRY - ANDERSON DAM
MAY, AUGUST, OCTOBER 1983 AND JANUARY 1984

Parameter	May		August		October		January	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
Turbidity (NTU)	1.4	1.7	1.2	6.4	0.4	0.7	1.5	0.6
Specific Conductance (mS/m)	9.6	9.5	11.5	9.9	9.6	9.8	11.7	11.3
pH (at 25°C)	7.4	7.4	7.6	6.7	7.5	7.4	7.0	7.1
Total Hardness ($CaCO_3$, mg/L)	40	40	40	44	42	42	49	45
Alkalinity (HCO_3 as $CaCO_3$, mg/L)	37		38		36		39	
Filtrable Residues 105°C (mg/L)	50	78	34	60	66	68	94	86
550°C (mg/L)	32	8	2	30	34	36	52	30
Non-Filtrable Residues 105°C (mg/L)	2	2	1	3	2	5	<2	<2
550°C (mg/L)	<1	<1	<1	2	<2	<2	<2	<2
Total Silica (mg SiO_2/L)	3.2	3.5	2.5	9.0	3.3	4.1	2.9	3.5
Soluble Silica (mg SiO_2/L)	2.6	2.6	1.9	4.4	2.6	2.8	2.7	2.7
Total Phosphorus (mg P/L)	<0.005	0.031	0.018	0.056	0.018	0.023	0.025	0.013
Soluble Phosphorus (mg P/L)	<0.002	<0.002	0.002	0.004	0.009	0.005	0.005	0.006
Total Kjeldahl Nitrogen (mg N/L)	0.33	0.34	0.34	0.33	0.31	0.34	0.86	0.37
Nitrate (mg NO_3/L)	<0.01	<0.01	0.01	0.03	<0.01	<0.01	0.08	<0.01
Total Organic Carbon (mg/L)	5	5	9	9	9	9	10	25
Total Inorganic Carbon (mg/L)	10	11	9	10	8	8	11	9
Sulphate (mg SO_4/L)	7.7	9.4	7.8	7.9	9.6	9.2	9.7	9.3
Chloride (mg/L)	1.7	1.7	1.7	1.4	1.8	1.9	4.0	4.0
Ammonia (mg NH_3/L)	<0.01	<0.01	<0.01	0.01	0.01	0.03	0.06	0.03
Calcium (mg/L)	11	11	11	12	12	12	14	13
Magnesium (mg/L)	3.0	3.0	3.0	3.4	3.3	3.3	3.6	3.3
Sodium (mg/L)	2.0	2.0	2.0	2.1	2.1	2.2	6.1	2.9
Potassium (mg/L)	0.75	0.77	0.70	0.86	0.75	0.83	1.28	0.84
Filtrable Iron (mg/L)	0.113	0.113	0.100[1]	3.200[1]	0.031	0.052	0.025	0.021
Total Iron (mg/L)	0.05	0.06	0.10	0.50	0.08	0.10	<0.05	<0.05
Nickel (mg/L)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Aluminum (mg/L)	<0.5	<0.05	<1	<1	<0.5	<0.5	<0.5	<0.5
Copper (mg/L)	<0.001	0.003	0.002	0.003	0.001	0.001	<0.001	<0.001
Zinc (mg/L)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	<0.02
Manganese (mg/L)	<0.05	<0.05	0.05	0.33	<0.05	<0.05	<0.05	<0.05
Mercury (filtered, mg/L)	<0.002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Arsenic (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

1 Sample collected on later date

APPENDIX 3 (cont'd)

Location Date	AKSL 01/19/84	AKSL 05/17/83	AKSL 06/17/83	AKSL 07/15/83	AKSL 08/06/83	AKSL 09/21/83	AKSL 10/27/83
Anabaena sp	0.0	0.0	72.8	188.5	369.2	2432.3	170.3
Aphanizomenon flos-aquae	5.0	0.0	0.0	0.0	0.0	5.0	0.0
Microcystis sp	0.0	0.0	0.0	19.2	4.8	0.0	3.2
Oscillatoria sp	0.0	48.0	0.0	0.0	0.0	0.0	0.0
Ankistrodesmus falcatus	0.0	0.0	0.0	3.0	0.0	1.5	0.0
Oocystis sp	0.0	5.0	0.0	0.0	0.0	0.0	0.0
Scenedesmus bijuga	28.0	0.8	0.0	0.0	0.0	4.0	6.4
Tetrahedron sp	0.0	0.0	0.0	0.0	0.0	0.0	9.5
Asterionella gracillima	25.6	352.0	0.0	0.0	0.0	0.0	0.0
Diatoma sp	0.0	172.5	0.0	0.0	0.0	0.0	0.0
Diatoma elongatum	24.2	0.0	0.0	0.0	0.0	0.0	0.0
Fragilaria crotonensis	73.6	0.0	16.0	4.8	0.0	8.0	0.0
Navicula sp	0.0	100.0	0.0	0.0	0.0	0.0	0.0
Synedra sp	20.0	590.0	0.0	0.0	840.0	0.0	0.0
Tabellaria sp	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Pennales	110.0	80.0	10.0	40.0	0.0	70.0	0.0
Melosira sp	0.0	489.3	0.0	69.9	0.0	0.0	1584.4
Stephanodiscus sp	0.0	0.0	1.7	0.0	0.0	0.0	0.0
Dinobryon sp	0.0	7.6	1.9	47.5	216.6	0.0	0.0
Dinobryon sociale	0.0	22.8	1.9	9.5	0.0	0.0	0.0
Cryptophyta Type 1	68.2	63.8	138.6	70.4	224.4	50.6	176.0
Cryptomonas sp	140.8	176.0	0.0	70.4	352.0	70.4	1196.8
Rhodomonas minuta	0.0	116.6	105.6	8.8	17.6	8.8	41.8
Peridinium sp	0.0	166.0	0.0	0.0	0.0	0.0	0.0

APPENDIX 3
ATIKOKAN PHYTOPLANKTON BIOMASS MAY 1983 - JAN 1984 (MG PER CUBIC METER)

Location Date	AKAB 01/19/84	AKAB 05/17/83	AKAB 06/17/83	AKAB 07/15/83	AKAB 08/06/83	AKAB 09/21/83	AKAB 10/27/83
Anabaena sp	0.0	0.0	2.6	13.0	23.4	96.2	0.0
Aphanizomenon flos-aquae	0.0	13.2	8.3	0.0	0.0	36.6	34.7
Microcystis sp	0.0	0.0	9.6	41.6	11.2	0.0	8.0
Oscillatoria sp	0.0	0.0	0.0	0.0	24.0	0.0	0.0
Ankistrodesmus falcatus	0.0	0.0	0.0	1.5	0.0	0.0	0.0
Ankistrodesmus mirabilis	0.0	0.2	0.0	0.0	0.0	0.0	0.0
Crucigenia sp	0.0	0.0	0.0	0.0	2.8	0.0	0.0
Oocystis sp	0.0	0.0	0.0	25.0	0.0	0.0	0.0
Scenedesmus bijuga	0.0	0.0	0.0	3.2	0.0	1.6	1.6
Tetrahedron sp	0.0	9.5	0.0	0.0	0.0	0.0	0.0
Asterionella gracillima	0.0	0.0	0.0	0.0	0.0	51.2	160.0
Diatoma sp	0.0	22.5	0.0	0.0	0.0	0.0	0.0
Fragilaria crotonensis	0.0	0.0	65.6	0.0	0.0	44.8	0.0
Synedra sp	15.0	130.0	0.0	0.0	0.0	0.0	0.0
Tabellaria sp	10.0	0.0	110.0	0.0	0.0	0.0	0.0
Pennales	25.0	50.0	70.0	0.0	10.0	0.0	90.0
Melosira sp	46.6	466.0	0.0	0.0	0.0	0.0	2632.9
Rhizosolenia sp	0.0	0.0	0.0	30.0	60.0	0.0	180.0
Stephanodiscus sp	0.9	0.9	10.2	1.7	0.0	0.0	0.0
Dinobryon sp	0.0	9.5	74.1	51.3	38.0	13.3	22.8
Dinobryon sociale	1.0	39.9	0.0	15.2	11.4	11.4	24.7
Cryptophyta Type 1	56.1	134.2	81.4	143.0	158.4	105.6	121.0
Cryptomonas sp	70.4	70.4	246.4	387.2	140.8	70.4	880.0
Rhodomonas minuta	3.3	30.8	63.8	72.6	55.0	26.4	63.8
Ceratium sp	0.0	0.0	350.0	0.0	350.0	0.0	0.0
Peridinium sp	0.0	0.0	0.0	166.0	0.0	0.0	0.0

APPENDIX 3 (cont'd)

Location Date	AKAD 01/19/84	AKAD 05/17/83	AKAD 06/17/83	AKAD 07/15/83	AKAD 08/06/83	AKAD 09/17/83	AKAD 10/27/83
Anabaena sp	26.0	0.0	0.0	0.0	0.0	126.8	1.3
Aphanizomenon flos-aquae	50.8	0.0	0.0	0.0	0.0	8.6	28.9
Microcystis sp	0.0	4.0	0.0	0.0	0.0	0.0	0.0
Oscillatoria sp	12.0	0.0	0.0	0.0	0.0	0.0	0.0
Ankistrodesmus falcatus	0.0	0.0	0.0	0.0	0.0	0.0	0.8
Ankistrodesmus mirabilis	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Crucigenia sp	0.0	0.0	0.0	0.0	0.0	1.4	0.0
Elakatothrix gelatinosa	0.0	0.0	0.0	2.0	0.0	4.0	0.0
Scenedesmus bijuga	0.0	0.0	0.0	0.0	1.6	0.4	0.0
Tetrahedron sp	0.0	23.8	0.0	0.0	0.0	0.0	0.0
Asterionella gracillima	0.0	16.0	12.8	0.0	0.0	6.4	0.0
Diatoma sp	0.0	3.8	0.0	0.0	0.0	0.0	1.9
Fragilaria crotonensis	6.4	0.0	0.0	1.6	20.8	0.0	0.0
Synedra sp	0.0	25.0	0.0	0.0	0.0	0.0	0.0
Tabellaria sp	0.0	0.0	30.0	30.0	0.0	5.0	0.0
Pennales	0.0	15.0	10.0	5.0	20.0	10.0	15.0
Melosira sp	0.0	0.0	0.0	0.0	0.0	186.4	93.2
Rhizosolenia sp	0.0	0.0	0.0	0.0	60.0	0.0	30.0
Stephanodiscus sp	0.0	0.4	1.7	1.7	0.0	0.4	0.4
Dinobryon sp	0.0	5.7	1.9	17.1	62.7	6.7	0.0
Dinobryon sociale	0.0	54.2	3.8	0.0	60.8	1.9	0.0
Cryptophyta Type 1	79.2	56.1	72.6	46.2	184.8	69.3	44.0
Cryptomonas sp	140.8	123.2	35.2	211.2	70.4	158.4	123.2
Rhodomonas minuta	0.0	44.0	88.0	18.7	30.8	18.7	9.9
Ceratium sp	0.0	0.0	0.0	0.0	350.0	0.0	0.0

APPENDIX 3 (cont'd)

Location Date	AKIC 01/19/84	AKIC 05/16/83	AKIC 06/17/83	AKIC 07/15/83	AKIC 08/06/83	AKIC 09/21/83	AKIC 10/27/83
Anabaena sp	0.0	0.0	55.9	36.4	9.1	132.6	0.0
Aphanizomenon flos-aquae	0.0	0.0	0.0	0.0	0.0	107.3	54.5
Microcystis sp	0.0	1.0	1.6	0.0	16.0	6.4	35.2
Ankistrodesmus falcatus	3.0	1.5	0.0	0.0	0.0	0.0	0.0
Ankistrodesmus mirabilis	0.0	0.2	0.0	0.0	0.0	0.0	0.0
Closteriopsis sp	0.0	0.0	0.0	0.0	0.0	0.0	4.2
Elakatothrix gelatinosa	0.0	0.0	4.0	0.0	0.0	2.0	0.0
Scenedesmus bijuga	6.0	0.0	0.8	0.0	0.0	0.8	1.6
Asterionella gracillima	19.2	51.2	19.2	51.2	0.0	0.0	0.0
Diatoma sp	0.0	18.8	0.0	0.0	0.0	0.0	0.0
Diatoma elongatum	0.0	48.4	0.0	0.0	0.0	0.0	0.0
Fragilaria crotonensis	43.2	0.0	40.0	0.0	27.2	6.4	0.0
Navicula sp	0.0	10.0	0.0	0.0	0.0	0.0	0.0
Synedra sp	0.0	250.0	0.0	0.0	0.0	0.0	0.0
Tabellaria sp	30.0	0.0	140.0	10.0	0.0	10.0	10.0
Pennales	55.0	0.0	0.0	40.0	10.0	20.0	100.0
Melosira sp	0.0	0.0	69.9	0.0	0.0	349.5	163.1
Rhizosolenia sp	0.0	0.0	0.0	0.0	0.0	0.0	60.0
Stephanodiscus sp	0.4	0.0	11.9	0.0	0.9	0.0	0.0
Dinobryon sp	1.9	24.7	64.6	58.9	24.7	3.8	19.0
Dinobryon sociale	0.0	53.2	0.0	0.0	20.9	5.7	19.0
Cryptophyta Type 1	93.5	35.2	110.0	323.4	50.6	198.0	215.6
Cryptomonas sp	35.2	246.4	492.8	70.4	246.4	352.0	774.4
Rhodomonas minuta	1.1	77.0	81.4	19.8	0.0	52.8	145.2

APPENDIX 3 (cont'd)

Location Date	AKMN 01/19/84	AKMN 05/17/83	AKMN 06/17/83	AKMN 07/15/83	AKMN 08/06/83	AKMN 09/21/83	AKMN 10/27/83
Anabaena sp	0.0	1.3	0.0	39.0	18.2	62.4	0.0
Aphanizomenon flos-aquae	48.8	0.0	5.0	0.0	0.0	41.3	0.0
Microcystis sp	0.0	21.2	1.6	9.6	0.0	3.2	0.0
Oscillatoria sp	24.0	0.0	0.0	0.0	0.0	0.0	0.0
Ankistrodesmus falcatus	0.0	0.0	0.0	0.0	0.0	1.5	0.0
Ankistrodesmus mirabilis	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Kirchneriella sp	0.0	0.0	0.0	0.0	0.0	5.0	0.0
Oocystis sp	0.0	0.0	2.5	5.0	5.0	0.0	0.0
Scenedesmus bijuga	0.8	0.0	0.0	0.0	0.0	0.0	0.4
Tetrahedron sp	0.0	4.8	0.0	0.0	0.0	0.0	0.0
Asterionella gracillima	32.0	0.0	22.4	121.6	19.2	153.6	0.0
Cymbella sp	0.0	5.0	0.0	0.0	0.0	0.0	0.0
Fragilaria crotonensis	25.6	0.0	0.0	0.0	0.0	0.0	0.0
Synedra sp	0.0	25.0	0.0	0.0	0.0	0.0	0.0
Tabellaria sp	210.0	5.0	0.0	50.0	0.0	0.0	0.0
Pennales	0.0	15.0	5.0	0.0	5.0	80.0	0.0
Melosira sp	23.3	174.8	23.3	0.0	0.0	0.0	0.0
Rhizosolenia sp	0.0	0.0	0.0	0.0	60.0	0.0	0.0
Stephanodiscus sp	0.9	2.1	1.3	4.3	0.0	0.0	0.0
Dinobryon sp	0.0	6.7	27.6	36.1	21.9	24.7	0.0
Dinobryon sociale	0.0	9.5	1.0	0.0	2.9	9.5	0.0
Mallomonas sp	0.0	20.4	0.0	0.0	0.0	0.0	0.0
Cryptophyta Type 1	37.4	35.2	89.1	136.4	118.8	200.2	9.9
Cryptomonas sp	35.2	264.0	17.6	176.0	105.6	176.0	0.0
Rhodomonas minuta	0.0	31.9	42.9	37.4	12.1	77.0	0.0

APPENDIX 3 (cont'd)

Location Date	AKMS 01/19/84	AKMS 05/17/83	AKMS 06/17/83	AKMS 07/15/83	AKMS 08/06/83	AKMS 09/21/83	AKMS 10/27/83
Anabaena sp	0.0	0.0	0.0	0.0	37.7	140.4	0.0
Aphanizomenon flos-aquae	51.5	0.0	0.0	0.0	4.0	142.9	130.4
Microcystis sp	0.0	14.4	0.0	25.6	16.0	36.8	0.0
Oscillatoria sp	30.0	0.0	0.0	0.0	0.0	0.0	240.0
Ankistrodesmus mirabilis	0.0	0.2	0.1	0.0	0.0	0.0	0.0
Closteriopsis sp	0.0	0.0	0.0	0.0	0.0	0.0	8.4
Crucigenia sp	0.0	0.0	0.0	0.0	0.0	0.0	11.2
Elakatothrix gelatinosa	0.0	0.0	0.0	2.0	0.0	0.0	0.0
Oocystis sp	0.0	2.5	2.5	0.0	0.0	0.0	0.0
Scenedesmus bijuga	0.0	0.0	0.8	0.0	0.0	0.0	0.0
Asterionella formosa	0.0	4.6	0.0	0.0	0.0	0.0	0.0
Asterionella gracillima	0.0	0.0	38.4	44.8	25.6	0.0	38.4
Fragilaria crotonensis	8.0	0.0	0.0	0.0	0.0	0.0	0.0
Synedra sp	0.0	5.0	0.0	0.0	0.0	0.0	0.0
Tabellaria sp	150.0	5.0	20.0	50.0	40.0	40.0	0.0
Pennales	0.0	40.0	40.0	0.0	10.0	30.0	20.0
Melosira sp	0.0	244.7	58.3	0.0	0.0	349.5	1095.1
Rhizosolenia sp	0.0	0.0	30.0	0.0	90.0	0.0	180.0
Stephanodiscus sp	2.6	0.9	2.1	1.7	2.6	0.0	2.6
Dinobryon sp	0.0	44.7	20.9	11.4	13.3	15.2	0.0
Dinobryon sociale	0.0	13.3	0.0	0.0	5.7	1.9	0.0
Cryptophyta Type 1	33.0	39.6	123.2	61.6	136.4	123.2	72.6
Cryptomonas sp	0.0	88.0	105.6	35.2	105.6	105.6	35.2
Rhodomonas minuta	0.0	36.3	47.3	61.6	6.6	48.4	19.8

APPENDIX 3 (cont'd)

Location Date	AKSLU 01/19/84	AKSLU 05/16/83	AKSLU 06/17/83	AKSLU 07/15/83	AKSLU 08/06/83	AKSLU 09/21/83	AKSLU 10/27/83
Anabaena sp	71.5	3.9	0.0	14.3	0.0	13.0	13.7
Aphanizomenon flos-aquae	90.8	133.7	146.9	0.0	0.0	13.2	1.7
Microcystis sp	0.0	3.2	0.0	6.4	57.6	19.2	12.8
Oscillatoria sp	0.0	69.0	0.0	0.0	0.0	0.0	0.0
Ankistrodesmus falcatus	6.0	4.5	0.0	0.0	0.0	0.0	1.5
Ankistrodesmus mirabilis	3.4	1.6	0.8	0.0	0.0	0.2	0.2
Cosmarium sp	0.0	0.0	132.0	0.0	0.0	0.0	0.0
Crucigenia sp	0.0	0.0	0.0	2.8	0.0	0.0	0.0
Elakatothrix gelatinosa	0.0	0.0	0.0	0.0	12.0	0.0	0.5
Golenkinia sp	0.0	0.0	0.0	0.0	0.0	0.0	6.5
Oocystis sp	0.0	0.0	0.0	10.0	0.0	0.0	0.0
Scenedesmus bijuga	0.0	0.0	0.0	0.0	0.0	0.8	0.8
Tetrahedron sp	0.0	19.0	9.5	28.5	0.0	0.0	0.0
Staurastrum sp	0.0	0.0	90.0	0.0	0.0	0.0	0.0
Asterionella gracillima	0.0	313.6	614.4	0.0	0.0	0.0	0.0
Fragilaria sp	52.5	0.0	0.0	0.0	6.0	0.0	0.0
Synedra sp	40.0	210.0	380.0	0.0	0.0	0.0	0.0
Tabellaria sp	70.0	0.0	0.0	0.0	0.0	40.0	0.0
Pennales	0.0	0.0	10.0	0.0	0.0	0.0	5.0
Rhizosolenia sp	0.0	300.0	0.0	0.0	0.0	0.0	0.0
Stephanodiscus sp	0.0	0.0	0.0	0.9	0.9	0.0	0.0
Dinobryon sp	3.8	321.1	108.3	13.3	3.8	19.0	1.9
Dinobryon sociale	0.0	17.1	19.0	1.9	0.0	0.0	0.0
Cryptophyta Type 1	74.8	70.4	114.4	66.0	68.2	44.0	29.7
Cryptomonas sp	140.8	211.2	35.2	0.0	0.0	140.8	0.0
Rhodomonas minuta	0.0	6.6	2.2	4.4	8.8	6.6	0.0

APPENDIX 4

ATIKOKAN ZOOPLANKTON DENSITIES MAY 1983 - JANUARY 1984 (No/m^3)

Location	AKAD	AKAD	AKAD	AKAD	AKAD	AKAD
Date	05/17/83	06/17/83	07/09/83	08/03/83	09/01/83	10/01/83
BRACHIONUS SPP	0	0	0	0	0	225
KERATELLA COCHLEARIS	11813	39150	17550	55125	51298	86625
KERATELLA QUADRATA	3713	0	550	3150	185	675
NOTHOLCA SPP	113	0	0	0	0	0
NOTHOLCA SQUAMULA	0	0	0	225	0	0
KELLICOTTIA LONGISPINA	10575	60525	16425	5850	2222	1450
LECANE SPP	113	0	0	0	0	0
TRICHOCERCA SPP	0	0	0	0	0	2925
TRICHOCERCA CYLINDRICA	0	0	550	0	4628	2475
TRICHOCERCA MULTICRINIS	0	0	550	4725	1481	550
TRICHOCERCA PORCELLUS	0	0	0	0	370	0
ASPLANCHNA SPP	5963	900	6075	5625	2591	2250
POLYARTHRA SPP	631	13500	6975	27225	36650	22725
SYNCHAETA SPP	900	500	1125	675	1296	225
PLOESOMA TRUNCATUM	0	0	0	0	1666	1350
FILINIA LONGISETA	226	500	0	0	370	550
CONOCHILUS UNICORNIS	0	500	550	1575	740	675
GASTROPUS SPP	1238	900	1800	4950	26099	17100
HEXARTHRA MIRA	0	0	0	0	0	225
UNIDENTIFIED ROTIFER	338	900	900	2250	2222	1350
DIAPHANOSOMA LEUCHTENBERGIANUM	0	0	0	550	740	0
DAPHNIA SPP	0	0	1350	1125	2777	1800
DAPHNIA LONGIREMIS	0	6750	2475	0	0	225
DAPHNIA GALEATA MENDOTAE	1350	13275	6750	900	740	550
DAPHNIA CATAWABA	0	0	0	0	0	225
CERIODAPHNIA LACUSTRIS	225	500	0	0	185	550
BOSMINA LONGIROSTRIS	1350	5400	550	2025	18695	36675
CHYDORUS SPHAERICUS	0	225	0	0	0	0
DIAPTOMUS OREGONENSIS	3150	5400	6750	2025	5183	1575
DIAPTOMUS MINUTUS	450	900	1125	1575	5553	675
CALANOIDA NAUPLIAR STAGES	8100	4050	8325	13275	14068	4275
CALANOIDA COPEPODITE STAGES	1575	2025	1350	1800	2777	550
CYCLOPS BICUSPIDATUS THOMASI	10900	8325	5850	6075	11106	14175
MESOCYCLOPS EDAX	1800	11250	550	550	1296	2475
CYCLOPOIDA NAUPLIAR STAGES	20250	8100	11475	26775	23138	7650
CYCLOPOIDA COPEPODITE STAGES	3375	8100	4275	4725	6849	4500

APPENDIX 4 (cont'd)

Location Date	AKMS 05/17/83	AKMS 06/17/83	AKMS 07/09/83	AKMS 08/05/83	AKMS 09/01/83	AKMS 10/01/83
KERATELLA COCHLEARIS	13553	39448	21267	15711	26026	47134
KERATELLA QUADRATA	1112	833	1746	317	317	0
KERATELLA HIEMALIS	139	0	0	0	0	0
NOTHOLCA SPP	139	0	0	0	0	0
KELLICOTTIA LONGISPINA	3545	13612	13331	1904	635	1111
LEDADELLA SPP	0	0	0	0	0	159
LECANE SPP	0	0	0	0	317	0
TRICHOCERCA SPP	0	278	0	0	0	476
TRICHOCERCA CYLINDRICA	0	0	317	1904	6031	0
TRICHOCERCA MULTICRINIS	0	0	635	2539	1270	159
TRICHOCERCA LONGISETA	0	0	0	635	0	0
ASPLANCHNA SPP	2919	4167	1746	4444	2222	1111
POLYARTHRA SPP	4657	12223	0	23488	13331	4825
SYNCHAETA SPP	278	556	0	2222	952	476
PLOESOMA SPP	0	0	0	0	635	159
PLOESOMA TRUNCATUM	0	0	0	2698	1270	317
FILINIA LONGISETA	1183	556	317	159	635	0
CONOCHILUS UNICORNIS	0	0	0	635	1270	1428
GASTROPUS SPP	973	3056	1428	9839	8252	6348
UNIDENTIFIED ROTIFER	0	278	794	2063	1587	1270
DIAPHANOSOMA LEUCHTENBERGIANUM	0	0	0	3968	2539	0
DAPHNIA SPP	0	0	1587	0	635	794
DAPHNIA LONGIREMIS	209	278	5396	317	0	0
DAPHNIA GALEATA MENDOTAE	0	278	13172	3809	1270	317
DAPHNIA PULEX	0	0	0	159	0	0
DAPHNIA CATAWABA	0	0	0	0	635	0
CERIODAPHNIA LACUSTRIS	0	0	0	635	952	0
BOSMINA LONGIROSTRIS	279	695	1587	8253	4761	1428
DIAPTOMUS OREGONENSIS	1112	695	3015	5078	3491	2857
DIAPTOMUS MINUTUS	70	139	635	635	1904	952
CALANOIDA NAUPLIAR STAGES	6533	6112	10316	3968	5713	3491
CALANOIDA COPEPODITE STAGES	1182	695	1904	1428	952	17457
CYCLOPS BICUSPIDATUS THOMASI	2434	417	7776	953	4444	6824
MESOCYCLOPS EDAX	209	278	1746	952	635	794
CYCLOPOIDA NAUPLIAR STAGES	8896	7084	15077	9522	12696	8252
CYCLOPOIDA COPEPODITE STAGES	1946	2500	3968	952	2222	2857

APPENDIX 4 (cont'd)

Location Date	AKMN 05/17/83	AKMN 06/17/83	AKMN 07/09/83	AKMN 08/03/83	AKMN 09/01/83	AKMN 10/01/83
KERATELLA COCHLEARIS	2741	69034	16390	17139	39675	32534
KERATELLA QUADRATA	624	695	556	1111	635	0
KERATELLA HIEMALIS	69	139	0	0	0	0
NOTHOLCA SQUAMULA	69	0	0	0	0	0
KELLICOTTIA LONGISPINA	972	2335	16946	4285	2857	159
LEPADELLA PATELLA	0	0	0	159	0	0
TRICHOCERCA SPP	0	139	0	159	0	0
TRICHOCERCA CYLINDRICA	104	0	0	159	5396	159
TRICHOCERCA MULTICRINIS	0	0	417	2381	1270	317
TRICHOCERCA PORCELLUS	0	0	0	0	0	635
ASPLANCHNA SPP	1180	4167	695	3491	952	1904
POLYARTHRA SPP	555	21807	3750	24916	19361	2857
SYNCHAETA SPP	486	278	278	2539	635	317
PLOESOMA SPP	0	0	139	159	0	0
PLOESOMA TRUNCATUM	0	0	0	0	2857	317
FILINIA LONGISETA	385	278	278	0	0	0
CONOCHILUS UNICORNIS	0	278	278	1746	635	3333
GASTROPUS SPP	729	2778	2639	3968	6983	7459
HEXARTHRA MIRA	0	0	0	159	0	0
UNIDENTIFIED ROTIFER	69	556	0	2539	1587	1270
DIAPHANOSOMA LEUCHTENBERGIANUM	0	0	0	1905	3491	0
DAPHNIA SPP	35	695	695	1904	2539	317
DAPHNIA LONGIREMIS	35	695	1945	635	317	159
DAPHNIA GALEATA MENDOTAE	0	556	4028	1111	2222	635
DAPHNIA PULEX	0	0	0	159	1270	0
DAPHNIA CATAWABA	0	0	0	0	634	0
CERIODAPHNIA LACUSTRIS	0	139	0	0	0	159
BOSMINA LONGIROSTRIS	70	5140	1250	18092	12378	317
CHYDORUS SPHAERICUS	0	0	0	635	0	0
DIAPTOMUS OREGONENSIS	659	2500	1945	3650	3174	1746
DIAPTOMUS MINUTUS	174	833	278	1428	2222	1428
CALANOIDA NAUPLIAR STAGES	3644	3889	7640	10474	13331	7142
CALANOIDA COPEPODITE STAGES	278	3334	1111	2857	952	476
CYCLOPS BICUSPIDATUS THOMASI	1041	8751	2639	2539	3427	3809
MESOCYCLOPS EDAX	104	1111	278	794	1270	1587
CYCLOPOIDA NAUPLIAR STAGES	5448	4584	15140	13172	23805	9522
CYCLOPOIDA COPEPODITE STAGES	521	8612	3056	4126	2539	1587

APPENDIX 4 (cont'd)

Location Date	AKIC 05/16/83	AKIC 06/17/83	AKIC 07/08/83	AKIC 08/04/83	AKIC 09/01/83	AKIC 10/01/83
KERATELLA COCHLEARIS	81450	193050	24075	38686	94950	182475
KERATELLA QUADRATA	14850	27450	2250	1481	0	550
KERATELLA HIEMALIS	6075	900	0	185	0	0
NOTHOLCA SQUAMULA	450	0	0	0	0	0
KELLICOTTIA LONGISPINA	59175	22950	4375	3888	7650	1450
TRICHOCERCA CYLINDRICA	0	0	3825	2591	5400	550
TRICHOCERCA MULTICRINIS	0	900	1800	1851	0	0
ASPLANCHNA SPP	49950	25200	9450	23693	7200	1575
POLYARTHRA SPP	3870	87750	22050	46830	107100	18675
SYNCHAETA SPP	675	1350	0	12772	6750	675
PLOESOMA SPP	0	0	550	370	0	0
PLOESOMA TRUNCATUM	0	0	0	740	50400	2475
FILINIA LONGISETA	2250	900	550	740	70200	225
CONOCHILUS UNICORNIS	0	12150	2025	0	1350	9000
GASTROPUS SPP	18675	182250	8775	26099	23850	34200
HEXARTHRA MIRA	0	0	0	2221	10350	0
UNIDENTIFIED ROTIFER	675	1350	675	7589	18000	1800
DIAPHANOSOMA LEUCHTENBERGIANUM	0	0	0	0	0	675
DAPHNIA SPP	0	1350	675	2221	450	2250
DAPHNIA LONGIREMIS	450	1350	4275	370	0	0
DAPHNIA GALEATA MENDOTAE	0	5400	5625	370	0	0
DAPHNIA PULEX	0	0	0	0	0	225
DAPHNIA CATAWABA	0	0	0	0	900	0
CERIODAPHNIA LACUSTRIS	0	0	0	370	2250	550
BOSMINA LONGIROSTRIS	0	5400	1800	25729	44550	18900
DIAPTOMUS OREGONENSIS	4725	2250	2700	926	3600	675
DIAPTOMUS MINUTUS	675	450	225	185	1350	225
CALANOIDA NAUPLIAR STAGES	20700	25650	10575	6479	12600	5175
CALANOIDA COPEPODITE STAGES	5850	3150	1125	740	1800	900
CYCLOPS BICUSPIDATUS THOMASI	6525	15300	2925	1111	6750	2925
MESOCYCLOPS EDAX	900	4050	675	0	450	550
CYCLOPOIDA NAUPLIAR STAGES	44550	34650	16200	12217	18900	12825
CYCLOPOIDA COPEPODITE STAGES	13725	10350	2250	1666	4050	2700

Location	AKSL	AKSL	AKSL	AKSL	AKSL	AKSL
Date	05/17/83	06/17/83	07/08/83	08/04/83	09/01/83	10/01/83
KERATELLA COCHLEARIS	321075	18360	19800	7200	24300	258525
KERATELLA QUADRATA	17325	5850	1800	675	0	1350
KERATELLA HIEMALIS	1125	1800	225	0	0	0
NOTHOLCA SPP	0	0	225	0	0	0
KELLICOTTIA LONGISPINA	0	90450	8775	675	5850	900
LECANE SPP	0	0	0	900	0	0
TRICHOCERCA SPP	675	0	0	0	0	0
TRICHOCERCA CYLINDRICA	0	1350	0	21600	19350	4050
TRICHOCERCA MULTICRINIS	0	0	2700	7425	1800	0
TRICHOCERCA LONGISETA	0	0	0	225	0	0
ASPLANCHNA SPP	25425	9000	5175	7200	20700	8550
POLYARTHRA SPP	46350	38700	12825	63675	252000	30150
SYNCHAETA SPP	2475	1800	0	3825	27900	3825
PLOESOMA SPP	0	0	0	0	450	0
PLOESOMA TRUNCATUM	0	0	0	0	4500	1800
FILINIA LONGISETA	1575	1350	225	675	10350	2925
CONOCHILUS UNICORNIS	0	11700	0	0	0	550
GASTROPUS SPP	11025	3150	1125	26775	25200	29925
HEXARTHRA MIRA	0	0	0	0	45450	675
UNIDENTIFIED ROTIFER	900	1800	900	3150	37350	3600
DIAPHANOSOMA LEUCHTENBERGIANUM	0	0	0	225	900	225
DAPHNIA SPP	0	8100	2475	2475	3600	1575
DAPHNIA LONGIREMIS	900	2250	4950	0	0	0
DAPHNIA GALEATA MENDOTAE	225	9000	18900	0	0	0
DAPHNIA CATAWABA	0	0	550	0	0	0
CERIODAPHNIA LACUSTRIS	0	1350	0	225	450	0
BOSMINA LONGIROSTRIS	2475	50400	4950	22275	52650	19575
CHYDORUS SPHAERICUS	0	0	0	225	0	0
DIAPTOMUS OREGONENSIS	9900	900	3600	1800	0	675
DIAPTOMUS MINUTUS	1125	1350	550	900	450	675
CALANOIDA NAUPLIAR STAGES	9450	24750	11250	8100	3600	2700
CALANOIDA COPEPODITE STAGES	15525	3600	2025	675	450	550
CYCLOPS BICUSPIDATUS THOMASI	9225	11250	5625	3825	2250	1450
MESOCYCLOPS EDAX	1125	2700	900	900	900	550
CYCLOPOIDA NAUPLIAR STAGES	11025	36900	27450	13500	9000	6975
CYCLOPOIDA COPEPODITE STAGES	21825	8550	4275	3375	900	2475

APPENDIX 4 (cont'd)

Location Date	AKAB 05/17/83	AKAB 06/17/83	AKAB 07/09/83	AKAB 08/03/83	AKAB 09/01/83	AKAB 10/01/83
KERATELLA COCHLEARIS	77001	55575	26325	19800	77850	53124
KERATELLA QUADRATA	8885	6750	6075	1350	900	555
KERATELLA HIEMALIS	1296	550	0	225	0	0
KELLICOTTIA LONGISPINA	51087	19125	8875	10125	8550	1666
LECANE SPP	370	0	0	0	0	0
TRICHOCERCA CYLINDRICA	0	0	0	3600	2700	0
TRICHOCERCA MULTICRINIS	0	0	1800	2700	1350	555
TRICHOCERCA LONGISETA	0	0	0	900	0	0
ASPLANCHNA SPP	8330	15750	2475	5400	3600	555
POLYARTHRA SPP	38686	39375	0	0	23850	3887
SYNCHAETA SPP	5368	1800	675	11700	3600	555
PLOESOMA TRUNCATUM	0	0	0	0	12150	0
FILINIA LONGISETA	1851	1125	550	900	4050	0
CONOCHILUS UNICORNIS	2962	675	0	450	8550	0
GASTROPUS SPP	10551	22725	2250	4275	13500	13327
UNIDENTIFIED ROTIFER	0	675	675	7425	3600	1111
DIAPHANOSOMA LEUCHTENBERGIANUM	0	0	0	0	1350	0
DAPHNIA SPP	185	2925	1575	2700	2250	555
DAPHNIA LONGIREMIS	185	3600	1800	1575	0	185
DAPHNIA GALEATA MENDOTAE	0	5625	6975	7425	3600	1296
DAPHNIA CATAWABA	370	550	675	550	450	185
BOSMINA LONGIROSTRIS	1296	7200	3375	0	8550	1666
DIAPTOMUS OREGONENSIS	3332	3600	2925	8650	4050	2591
DIAPTOMUS MINUTUS	1850	1125	550	0	3600	1111
CALANOIDA NAUPLIAR STAGES	20731	11700	26775	16875	12600	5553
CALANOIDA COPEPODITE STAGES	4442	2925	1350	1350	900	1481
TROPOCYCLOPS PRASINUS	370	0	0	0	0	0
CYCLOPS BICUSPIDATUS THOMASI	5367	7075	3600	2475	4500	5553
MESOCYCLOPS EDAX	1111	1350	1125	0	0	555
CYCLOPOIDA NAUPLIAR STAGES	35169	14850	66825	26325	27000	31097
CYCLOPOIDA COPEPODITE STAGES	6108	7425	3375	4275	2700	2036

APPENDIX 4 (cont'd)

Location Date	AKSLU 05/16/83	AKSLU 06/17/83	AKSLU 07/08/83	AKSLU 08/04/83	AKSLU 09/01/83	AKSLU 10/01/83
KERATELLA COCHLEARIS	138069	4444	15554	4170	10556	6718
KERATELLA QUADRATA	6665	4920	476	1946	1111	159
KERATELLA HIEMALIS	1587	317	159	0	1389	53
NOTHOLCA SQUAMULA	635	0	0	0	0	0
KELLICOTTIA LONGISPINA	4126	5554	1904	3892	3890	793
TRICHOCERCA SPP	0	159	0	0	0	0
TRICHOCERCA CYLINDRICA	0	0	476	0	1667	53
TRICHOCERCA MULTICRINIS	0	0	0	1668	556	0
TRICHOCERCA PORCELLUS	0	0	0	0	0	53
ASPLANCHNA SPP	8729	7618	0	2502	833	159
POLYARTHRA SPP	26185	21742	3809	7506	10001	688
SYNCHAETA SPP	0	3015	794	3058	1667	0
PLOESOMA SPP	0	0	0	0	0	53
PLOESOMA TRUNCATUM	0	0	0	834	556	53
FILINIA LONGISETA	2539	476	0	1946	5834	159
CONOCHILUS UNICORNIS	0	317	1746	1390	556	794
GASTROPUS SPP	6189	1746	1270	3336	2222	846
HEXARTHRA MIRA	476	0	0	0	0	0
UNIDENTIFIED ROTIFER	476	476	635	2224	1389	370
DIAPHANOSOMA LEUCHTENBERGIANUM	0	0	0	278	833	0
DAPHNIA SPP	159	635	635	2224	1945	0
DAPHNIA LONGIREMIS	0	318	318	1112	833	53
DAPHNIA GALEATA MENDOTAE	0	159	635	1390	1667	370
DAPHNIA CATAWABA	0	0	0	0	278	0
CERIODAPHNIA LACUSTRIS	0	0	0	278	0	53
BOSMINA LONGIROSTRIS	317	1905	1271	5282	1945	529
CHYDORUS SPHAERICUS	0	0	476	0	2222	0
DIAPTOMUS OREGONENSIS	2539	635	1748	3892	2500	370
DIAPTOMUS MINUTUS	635	159	318	556	833	0
CALANOIDA NAUPLIAR STAGES	1904	10633	7468	4726	3611	423
CALANOIDA COPEPODITE STAGES	794	952	795	1112	1111	53
CYCLOPS BICUSPIDATUS THOMASI	1270	953	1430	4726	10000	476
MESOCYCLOPS EDAX	476	317	318	0	1111	159
CYCLOPOIDA NAUPLIAR STAGES	4444	4602	17956	14456	8334	529
CYCLOPOIDA COPEPODITE STAGES	2539	476	1748	3336	3611	317

APPENDIX 5

LARVAL TOW CATCH DATA ATIKOKAN 1983
(Duplicate Net Totals)

SNOW LAKE											
Date	05-12	05-24		06-07		06-19		07-08		07-12	
Inlet/Outlet		I	O	I	O	I	O	I	O	I	O
Temperature (°C)	8.8	13.5	13.5	17.0	18.0	20.0	20.0	23.3	23.0	24.5	24.5
Cisco	0	2	0	0	0	0	0	0	0	0	0
Yellow Perch	0	0	3	6	6	3	1	15	4	61	7
White Sucker	0	0	0	1	0	0	0	0	0	0	0
Cyprinidae	0		0	0	0	0	0	11	5	211	5
Pumpkinseed	0	0	0	0	0	0	0	22	7	76	1
ICY LAKE											
Date	05-12	05-24		06-07		06-18		07-07		07-12	
Inlet/Outlet		I	O	I	O	I	O	I	O	I	O
Temperature (°C)	9.5	11.5	11.5	14.2	14.1	20.0	19.0	22.3	21.8	24.0	23.5
Yellow Perch	0	0	10	13	7	4	25	0	3	0	4
White Sucker	0	0	0	0	20	2	2	0	0	0	0
Cyprinidae	0	0	0	0	0	0	0	0	6	3	2
Pumpkinseed	0	0	0	0	0	0	0	4	13	0	3
Ninespine Stickleback	0	0	0	0	0	0	0	0	0	0	1
ABIE LAKE											
Date	05-12	05-25		06-09		06-18		07-06		07-11	
Inlet/Outlet		I	O	I	O	I	O	I	O	I	O
Temperature (°C)	14.0	13.0	13.4	15.0	15.5	18.8	19.0	23.3	23.0	23.5	23.5
Lake Whitefish	1	0	0	0	0	0	0	0	0	0	0
Yellow Perch	0	0	3	0	8	0	1	2	0	0	0
Burbot	0	1	0	0	0	0	0	0	0	0	0
White Sucker	0	0	0	0	0	1	0	0	0	0	0
Ninespine Stickleback	0	0	0	0	0	1	0	0	0	0	0
Cyprinidae	0	0	0	0	0	0	0	90	71	103	3
Pumpkinseed	0	0	0	0	0	0	0	5	7	0	0
Iowa Darter	0	0	0	0	0	0	0	0	3	0	0

APPENDIX 5 (cont'd)

	SLUSH LAKE						LOWER SEINE					
Date	05-12	05-24	06-07	06-19	07-08	07-12	05-12	05-25	06-09	06-18	07-06	07-11
Temperature (°C)	11.0	12.2	14.0	19.5	22.8	23.0	9.0	12.0	14.0	18.8	21.6	23.0
Cisco	42	64	0	0	0	0	0	0	0	0	0	0
Yellow Perch	0	0	33	1	4	25	0	0	1	3	3	3
Lake Whitefish	0	0	0	0	0	0	1	0	0	0	0	0
Cyprinidae	0	0	0	0	0	0	0	0	0	0	3	0
Pumpkinseed	0	0	0	0	0	0	0	0	0	0	0	1

	MARMION SOUTH						MARMION CENTRAL					
Date	05-12	05-25	06-09	06-18	07-06	07-11	05-12	05-25	06-09	06-18	07-06	07-11
Temperature (°C)	8.0	11.5	15.0	19.0	20.0	23.0	8.4	11.2	15.0	17.0	19.3	21.0
Lake Whitefish	2	0	0	0	0	0	3	0	0	0	0	0
Yellow Perch	0	0	0	1	0	0	0	0	0	4	0	0
Ninespine Stickleback	0	0	1	0	0	0	0	0	0	1	0	0
Cyprinidae	0	0	0	3	3	0	0	0	0	0	2	0
Iowa Darter	0	0	0	0	0	0	0	0	0	0	2	0
Pumpkinseed	0	0	0	0	0	0	0	0	0	0	0	1

APPENDIX 5 (cont'd)

	MARMION NORTH						ANDERSON DAM					
Date	05-12	05-25	06-09	06-18	07-06	07-11	05-12	05-25	06-09	06-18	07-06	07-11
Temperature (°C)	7.0	9.5	13.0	19.0	19.8	24.0	9.0	11.5	14.0	-	19.5	24.5
Cisco	0	0	0	0	0	0	1	0	0	0	0	0
Lake Shitefish	0	0	0	0	0	0	2	0	0	0	0	0
Yellow Perch	0	0	0	0	0	0	0	0	0	1	0	0
Cyprinidae	0	0	0	0	25	4	0	0	0	0	0	1
Iowa Darter	0	0	0	0	8	0	0	0	0	0	0	0

	MOOSE LAKE					
Date	05-15	05-24	06-13	06-20	07-07	07-13
Temperature (°C)	8.0	11.0	18.0	18.0	22.0	24.0
Lake Whitefish	2	0	0	0	0	0
Burbot	1	0	1	0	0	0
Yellow Perch	0	0	11	45	34	4
White Sucker	0	0	0	1	0	0
Cyprinidae	0	0	0	0	28	3

APPENDIX 6

FISH CATCH IN BEACH SEINES ATIKOKAN 1983

Location	AKSL	AKSL	AKSL	AKSL	AKSL	AKSL	AKSL	AKSL	AKSL	AKSL	AKSL	AKSL
Date	05/13	05/13	05/13	06/13	06/13	06/13	07/08	07/08	07/08	08/04	08/04	08/04
Veg (Y/N)	N	N	Y	N	N	Y	N	N	Y	N	N	Y
WHITE SUCKER	0	2	2	0	0	0	8	0	5	1	1	1
CYPRINIDAE	0	0	0	0	0	0	0	0	0	139	0	19
LAKE CHUB	0	0	0	0	0	0	0	0	0	1	1	0
GOLDEN SHINER	0	0	0	0	0	0	0	0	0	4	0	6
BLACKNOSE SHINER	1	1	34	0	0	0	27	0	52	70	4	4
MIMIC SHINER	0	0	0	0	0	0	1	0	0	1	7	0
PUMPKINSEED	0	0	0	0	0	0	1	0	0	11	3	0
YELLOW PERCH	0	1	0	0	0	0	36	2	16	22	44	33
IOWA DARTER	12	11	10	2	0	0	3	0	2	31	7	4

Location	AKSL	AKSL	AKSL	AKSL	AKSL	AKSL	AKSL	AKSL	AKSL
Date	09/01	09/01	09/01	10/01	10/01	10/01	10/26	10/26	10/26
Veg (Y/N)	N	N	Y	N	N	Y	N	N	Y
WHITE SUCKER	0	0	3	0	0	0	0	0	0
LAKE CHUB	0	4	3	0	0	0	0	0	0
GOLDEN SHINER	5	0	0	0	1	1	0	0	0
BLACKNOSE SHINER	59	122	30	0	6	5	0	0	0
MIMIC SHINER	478	12	989	0	193	7	0	0	0
PUMPKINSEED	4	12	9	0	2	0	0	0	0
YELLOW PERCH	49	24	93	14	13	13	0	0	2
IOWA DARTER	21	3	9	3	9	15	1	0	0
SLIMY SCULPIN	0	0	0	0	0	1	0	0	0

APPENDIX 6 (cont'd)

Location	AKIC	AKIC	AKIC	AKIC	AKIC	AKIC	AKIC	AKIC	AKIC	AKIC	AKIC	AKIC
Date	05/09	05/09	05/09	06/07	06/07	06/07	07/07	07/07	07/07	08/04	08/04	08/04
Veg (Y/N)	N	N	Y	N	N	Y	N	N	Y	N	N	Y
WHITE SUCKER	0	0	1	0	0	0	27	0	2	2	14	1
CYPRINIDAE	0	0	0	0	0	0	0	0	3	0	0	0
LAKE CHUB	0	0	0	0	3	0	0	0	0	0	1	0
GOLDEN SHINER	0	1	0	2	0	0	0	0	0	0	0	0
BLACKNOSE SHINER	0	0	7	120	24	2	4	55	0	1	4	0
SPOTTAIL SHINER	0	0	0	0	1	4	3	2	0	11	12	8
MIMIC SHINER	0	0	0	1	16	1	0	0	0	0	0	0
FATHEAD MINNOW	0	0	0	0	2	0	0	0	0	0	0	0
LONGNOSE DACE	0	0	0	1	0	0	0	0	0	3	7	0
PUMPKINSEED	0	0	0	0	0	0	0	0	0	0	0	1
YELLOW PERCH	1	5	4	0	3	709	57	1	0	1	25	42
IOWA DARTER	0	3	3	7	1	0	7	8	0	0	2	0
LOG PERCH	0	1	0	0	0	0	10	0	0	6	0	0

Location	AKIC	AKIC	AKIC	AKIC	AKIC	AKIC	AKIC	AKIC	AKIC
Date	09/01	09/01	09/01	10/01	10/01	10/01	10/25	10/25	10/25
Veg (Y/N)	N	N	Y	N	N	Y	N	N	Y
WHITE SUCKER	1	1	0	0	0	0	0	0	0
LAKE CHUB	1	0	0	0	0	0	0	0	0
BLACKNOSE SHINER	0	1	0	1	6	0	1	2	58
SPOTTAIL SHINER	11	22	27	10	7	29	2	0	2
MIMIC SHINER	0	0	0	0	1	0	0	0	0
LONGNOSE DACE	0	0	1	0	0	0	0	0	0
PUMPKINSEED	25	19	44	9	0	0	1	0	0
YELLOW PERCH	8	14	12	7	0	1	0	0	2
IOWA DARTER	2	3	3	1	2	0	1	1	2
LOG PERCH	4	3	4	3	1	2	0	0	1

APPENDIX 6 (cont'd)

Location	AKAB	AKAB	AKAB	AKAB	AKAB	AKAB	AKAB	AKAB	AKAB	AKAB	AKAB	AKAB
Date	05/09	05/09	05/09	06/09	06/09	06/09	07/07	07/07	07/07	08/03	08/03	08/03
Veg (Y/N)	N	N	Y	N	N	Y	N	N	Y	N	N	Y
NORTHERN PIKE	0	0	0	0	0	0	0	1	1	0	0	0
WHITE SUCKER	0	0	0	0	0	0	5	0	41	0	0	0
CYPRINIDAE	0	0	0	0	0	0	0	0	0	62	0	0
GOLDEN SHINER	0	0	0	0	0	0	0	0	0	1	0	0
BLACKNOSE SHINER	0	0	2	0	0	1	83	17	235	463	2	253
SPOTTAIL SHINER	0	0	0	0	0	0	0	0	0	8	1	18
MIMIC SHINER	0	0	1	0	0	0	0	0	0	0	0	0
BURBOT	0	0	0	0	1	0	0	0	0	0	0	0
NINESPINE STICKLEBACK	1	0	0	0	0	0	0	0	0	0	0	0
PUMPKINSEED	0	0	0	0	0	0	0	0	0	16	1	3
YELLOW PERCH	0	0	0	0	0	0	2	3	6	1	0	1
WALLEYE	0	0	0	0	0	0	1	0	4	0	0	0
IOWA DARTER	0	0	2	1	0	7	0	3	1	0	0	0

Location	AKAB	AKAB	AKAB	AKAB	AKAB	AKAB	AKAB	AKAB	AKAB
Date	09/01	09/01	09/01	10/01	10/01	10/01	10/25	10/25	10/25
Veg (Y/N)	N	N	Y	N	N	Y	N	N	Y
WHITE SUCKER	0	3	0	0	0	0	0	0	0
GOLDEN SHINER	12	0	0	1	0	1	0	0	0
BLACKNOSE SHINER	64	3	27	5	1	21	2	0	3
SPOTTAIL SHINER	5	0	6	0	0	1	0	0	0
MIMIC SHINER	314	76	34	8	0	470	0	0	0
PUMPKINSEED	1	0	9	0	11	2	4	0	15
YELLOW PERCH	0	0	4	0	0	0	0	0	2
IOWA DARTER	1	1	1	1	0	0	2	0	0
LOG PERCH	1	0	0	0	0	0	0	0	0

APPENDIX 6 (cont'd)

Location	AKSLU	AKSLU	AKSLU	AKSLU	AKSLU	AKSLU	AKSLU	AKSLU	AKSLU	AKSLU	AKSLU	AKSLU
Date	05/12	05/12	05/12	06/09	06/09	06/09	07/08	07/08	07/08	08/04	08/04	08/04
Veg (Y/N)	N	N	Y	N	N	Y	N	N	Y	N	N	Y
BLACKNOSE SHINER	0	0	0	0	0	0	90	0	0	2	0	193
IOWA DARTER	0	0	0	0	0	0	0	0	0	0	1	0

Location	AKSLU	AKSLU	AKSLU	AKSLU	AKSLU	AKSLU	AKSLU	AKSLU	AKSLU
Date	09/01	09/01	09/01	10/01	10/01	10/01	10/25	10/25	10/25
Veg (Y/N)	N	N	Y	N	N	Y	N	N	Y
NO FISH CAPTURED									

APPENDIX 6 (cont'd)

Location	AKLS	AKLS	AKLS	AKLS	AKLS	AKLS	AKLS	AKLS	AKLS	AKLS	AKLS	AKLS
Date	05/12	05/12	05/12	06/09	06/09	06/09	07/11	07/11	07/11	08/05	08/05	08/05
Veg (Y/N)	N	N	Y	N	N	Y	N	N	Y	N	N	Y
CENTRAL MUDMINNOW	0	0	0	0	0	0	0	0	0	0	0	1
WHITE SUCKER	0	0	0	0	0	0	15	0	10	11	7	0
CYPRINIDAE	0	0	0	0	0	2	0	0	0	0	0	0
LAKE CHUB	0	0	0	0	0	0	0	0	0	0	1	0
BLACKNOSE SHINER	0	0	0	0	0	0	27	4	8	1	6	13
SPOTTAIL SHINER	0	0	0	0	0	0	0	0	0	2	10	1
MIMIC SHINER	1	0	0	0	0	0	0	0	0	0	0	0
PUMPKINSEED	0	0	0	0	0	0	0	1	0	1	1	2
YELLOW PERCH	0	0	0	0	0	0	4	2	3	11	19	13
IOWA DARTER	7	6	0	0	0	0	19	82	56	10	35	59
LOG PERCH	0	2	0	0	0	0	3	5	3	4	2	0
SLIMY SCULPIN	5	1	0	0	0	0	0	0	0	0	0	0

Location	AKLS	AKLS	AKLS	AKLS	AKLS	AKLS	AKLS	AKLS	AKLS
Date	09/01	09/01	09/01	10/01	10/01	10/01	10/25	10/25	10/25
Veg (Y/N)	N	N	Y	N	N	Y	N	N	Y
REDBELLY DACE	4	0	0	0	0	0	0	0	0
GOLDEN SHINER	0	0	0	0	0	8	0	0	0
BLACKNOSE SHINER	7	0	0	1	0	1	0	0	0
SPOTTAIL SHINER	0	0	0	0	0	0	1	10	0
MIMIC SHINER	0	0	0	1	0	82	78	1062	16
FATHEAD MINNOW	0	3	0	0	0	0	0	0	0
NOTROPIS SP	0	0	0	0	0	0	0	1	0
PUMPKINSEED	0	0	1	0	0	0	0	0	0
YELLOW PERCH	1	2	0	1	0	1	0	6	18
IOWA DARTER	36	10	34	0	0	0	0	0	0

APPENDIX 6 (cont'd)

Location	AKMS	AKMS	AKMS	AKMS	AKMS	AKMS	AKMS	AKMS	AKMS	AKMS	AKMS	AKMS
Date	05/12	05/12	05/12	06/14	06/14	06/14	07/09	07/09	07/09	08/05	08/05	08/05
Veg (Y/N)	N	N	Y	N	N	Y	N	N	Y	N	N	Y
NORTHERN PIKE	0	0	0	0	0	1	0	0	0	0	0	0
WHITE SUCKER	0	0	0	0	0	0	12	4	1	0	0	0
REDBELLY DACE	0	0	0	0	0	0	1	0	0	0	0	0
GOLDEN SHINER	3	0	0	1	0	4	0	0	0	2	2	1
BLACKNOSE SHINER	0	36	1	3	0	37	101	64	16	2	0	1
SPOTTAIL SHINER	0	0	0	0	0	2	0	0	0	21	4	5
MIMIC SHINER	0	0	0	43	0	5	0	0	0	2	0	0
NINESPINE STICKLEBACK	0	1	0	0	0	0	0	0	0	0	0	0
PUMPKINSEED	0	0	0	0	0	0	0	0	0	0	0	1
YELLOW PERCH	1	4	4	0	0	11	1	9	1	19	31	56
IOWA DARTER	0	5	17	3	0	2	1	0	0	1	2	1
LOG PERCH	0	0	0	0	0	0	0	0	0	0	1	0
SLIMY SCULPIN	0	0	0	1	0	0	0	0	0	0	0	0

Location	AKMS	AKMS	AKMS	AKMS	AKMS	AKMS	AKMS	AKMS	AKMS
Date	09/01	09/01	09/01	10/01	10/01	10/01	10/25	10/25	10/25
Veg (Y/N)	N	N	Y	N	N	Y	N	N	Y
GOLDEN SHINER	3	1	38	0	0	0	0	0	0
BLACKNOSE SHINER	0	0	2	24	0	0	0	0	0
SPOTTAIL SHINER	0	2	1	1	0	1	0	0	0
MIMIC SHINER	0	5	1	204	1	96	0	0	0
NINESPINE STICKLEBACK	0	0	0	2	0	0	0	0	0
PUMPKINSEED	1	3	9	0	0	0	0	0	0
YELLOW PERCH	10	1	5	73	0	1	0	0	1
IOWA DARTER	0	0	1	0	0	1	0	0	1
LOG PERCH	0	0	0	0	0	1	0	0	0

APPENDIX 6 (cont'd)

Location	AKMC	AKMC	AKMC	AKMC	AKMC	AKMC	AKMC	AKMC	AKMC	AKMC	AKMC	AKMC
Date	05/12	05/12	05/12	06/09	06/09	06/09	07/11	07/11	07/11	08/03	08/03	08/03
Veg (Y/N)	N	N	Y	N	N	Y	N	N	Y	N	N	Y
SPOTTAIL SHINER	0	0	0	0	0	0	0	0	0	0	0	3
MIMIC SHINER	0	0	0	0	0	0	1	37	0	7	8	0
YELLOW PERCH	0	0	0	0	0	0	0	6	0	2	2	4

Location	AKMC	AKMC	AKMC	AKMC	AKMC	AKMC	AKMC	AKMC	AKMC
Date	09/01	09/01	09/01	10/01	10/01	10/01	10/25	10/25	10/25
Veg (Y/N)	N	N	Y	N	N	Y	N	N	Y
BLACKNOSE SHINER	1	0	0	0	0	0	0	0	0
MIMIC SHINER	3	23	498	0	0	0	0	0	0
FATHEAD MINNOW	1	0	0	0	0	0	0	0	0

APPENDIX 6 (cont'd)

Location	AKMN	AKMN	AKMN	AKMN	AKMN	AKMN	AKMN	AKMN	AKMN	AKMN	AKMN	AKMN
Date	05/12	05/12	05/12	06/09	06/09	06/09	07/09	07/09	07/09	08/03	08/03	08/03
Veg (Y/N)	N	N	Y	N	N	Y	N	N	Y	N	N	Y
WHITE SUCKER	0	0	0	0	0	0	4	110	0	0	2	3
BLACKNOSE SHINER	0	0	0	0	0	0	1	0	0	275	143	99
SPOTTAIL SHINER	0	0	0	0	0	0	0	0	0	0	1	0
MIMIC SHINER	0	0	0	0	0	0	0	0	0	90	30	8
YELLOW PERCH	0	0	0	0	0	0	5	7	0	220	34	33

Location	AKMN	AKMN	AKMN	AKMN	AKMN	AKMN	AKMN	AKMN	AKMN
Date	09/01	09/01	09/01	10/01	10/01	10/01	10/25	10/25	10/25
Veg (Y/N)	N	N	Y	N	N	Y	N	N	Y
GOLDEN SHINER	0	0	1	0	0	0	0	0	0
BLACKNOSE SHINER	130	1	189	0	0	0	0	0	0
SPOTTAIL SHINER	1	0	0	0	0	0	0	0	0
MIMIC SHINER	67	1	2	0	0	0	0	0	0
NINESPINE STICKLEBACK	0	0	1	0	0	0	0	0	0
PUMPKINSEED	2	0	0	0	0	0	0	0	0
YELLOW PERCH	6	0	5	0	0	0	0	0	0

APPENDIX 6 (cont'd)

Location	AKAD	AKAD	AKAD	AKAD	AKAD	AKAD	AKAD	AKAD	AKAD	AKAD	AKAD	AKAD
Date	05/12	05/12	05/12	06/14	06/14	06/14	07/09	07/09	07/09	08/03	08/03	08/03
Veg (Y/N)	N	N	Y	N	N	Y	N	N	Y	N	N	Y
WHITE SUCKER	0	0	0	0	0	0	1	3	0	0	2	0
BLACKNOSE SHINER	0	0	0	0	0	105	198	127	13	64	23	2
SPOTTAIL SHINER	0	0	0	2	0	0	2	0	0	4	2	6
MIMIC SHINER	0	0	0	1	0	7	0	0	0	131	3	37
YELLOW PERCH	0	0	0	0	0	0	7	21	1	55	15	30
WALLEYE	0	0	0	0	0	0	0	0	0	2	0	0
IOWA DARTER	0	0	0	0	0	4	0	0	0	0	3	0
LOG PERCH	0	0	0	4	0	0	60	0	4	43	11	0

Location	AKAD	AKAD	AKAD	AKAD	AKAD	AKAD	AKAD	AKAD	AKAD
Date	09/01	09/01	09/01	10/02	10/02	10/02	10/26	10/26	10/26
Veg (Y/N)	N	N	Y	N	N	Y	N	N	Y
WHITE SUCKER	1	2	2	0	0	0	0	0	0
REDBELLY DACE	0	1	0	0	0	0	0	0	0
BLACKNOSE SHINER	0	0	40	0	0	0	0	0	4
SPOTTAIL SHINER	1	11	1	0	0	4	0	0	1
MIMIC SHINER	7	114	0	0	0	0	0	0	0
FATHEAD MINNOW	0	0	0	0	0	0	0	0	1
PUMPKINSEED	0	0	15	0	0	0	0	0	0
YELLOW PERCH	4	18	16	0	0	50	0	0	28
IOWA DARTER	0	0	0	0	0	0	0	0	1
LOG PERCH	155	118	0	0	0	14	0	0	0

APPENDIX 6 (cont'd)

Location	AKML	AKML	AKML	AKML	AKML	AKML	AKML	AKML	AKML	AKML	AKML	AKML
Date	05/12	05/12	05/12	06/13	06/13	06/13	07/07	07/07	07/07	08/05	08/05	08/05
Veg (Y/N)	N	N	Y	N	N	Y	N	N	Y	N	N	Y
GOLDEN SHINER	0	0	0	0	0	0	0	0	0	4	3	0
BLACKNOSE SHINER	0	0	0	0	0	0	14	1	0	0	47	0
MIMIC SHINER	0	0	0	3	0	0	2	0	0	8	3	1
YELLOW PERCH	0	0	0	0	0	0	1	0	0	0	15	1
IOWA DARTER	0	0	0	3	0	0	0	4	0	1	9	14
LOG PERCH	0	0	0	0	0	0	0	0	0	1	0	3

Location	AKML	AKML	AKML	AKML	AKML	AKML	AKML	AKML	AKML
Date	09/01	09/01	09/01	10/01	10/01	10/01	10/25	10/25	10/25
Veg (Y/N)	N	N	Y	N	N	Y	N	N	Y
LAKE CHUB	1	0	0	0	0	0	0	0	0
GOLDEN SHINER	15	46	0	0	0	0	0	0	0
BLACKNOSE SHINER	353	3	96	0	0	0	0	0	0
MIMIC SHINER	1	8	1	0	0	0	0	0	0
IOWA DARTER	3	0	1	0	0	0	0	0	0
LOG PERCH	1	0	0	0	0	0	0	0	0

APPENDIX 7

FISH CATCH IN GILL NETS ATIKOKAN 1983.
Records are shown as mesh size (inches) species and number.

SITE: AKMS
DATE 525
DURATION 1.5
TIME OF SET 1700
TEMPERATURE 11 deg C

1	4 COMMON WHITE SUCKER 1
1	4 LAKE WHITEFISH 1
1	3.5 LAKE WHITEFISH 1
1	3 YELLOW PICKEREL 1

SITE: AKMB
DATE 517
DURATION 2
TIME OF SET 1730
TEMPERATURE 9 deg C

2	3.5 COMMON WHITE SUCKER 1
2	3.5 LAKE WHITEFISH 1
2	3 CISCO 1
2	3 LAKE WHITEFISH 4

SITE: AKMC
DATE 512
DURATION 2
TIME OF SET 1700
TEMPERATURE 8.4 deg C

3	3 YELLOW PICKEREL 1
3	2 YELLOW PICKEREL 1
3	2 COMMON WHITE SUCKER 2
3	1.5 LAKE WHITEFISH 2

SITE: AKMC
DATE 525
DURATION 2.5
TIME OF SET 1550
TEMPERATURE 11.5 deg C

4	3 NORTHERN PIKE 1
4	1.5 YELLOW PICKEREL 1
4	1.5 COMMON WHITE SUCKER 2

SITE: AKLS
DATE 525
DURATION 2.5
TIME OF SET 1750
TEMPERATURE 11.8 deg C

5	4.5 LAKE WHITEFISH 1
5	4 LAKE WHITEFISH 2
5	3.5 LAKE WHITEFISH 1

SITE: AKLS
DATE 512
DURATION 2
TIME OF SET 1600
TEMPERATURE 7 deg C

6	2 LAKE WHITEFISH 1

SITE: AKAD
DATE 525
DURATION 2.5
TIME OF SET 1900
TEMPERATURE 10 deg C

7	5 COMMON WHITE SUCKER 1
7	4.5 COMMON WHITE SUCKER 1
7	4 COMMON WHITE SUCKER 1
7	3 COMMON WHITE SUCKER 1
7	2.5 YELLOW PICKEREL 2
7	2.5 LAKE WHITEFISH 2
7	2 COMMON WHITE SUCKER 1

SITE: AKAD
DATE 516
DURATION 3
TIME OF SET 1800
TEMPERATURE 11 deg C

8	5 COMMON WHITE SUCKER 1
8	4.5 COMMON WHITE SUCKER 2
8	3 COMMON WHITE SUCKER 1
8	2.5 YELLOW PICKEREL 1
8	2.5 NORTHERN PIKE 2

SITE: AKML
DATE 524
DURATION 3.5
TIME OF SET 1600
TEMPERATURE 11 deg C

9	1 1

SITE: AKML
DATE 515
DURATION 3
TIME OF SET 1600
TEMPERATURE 8 deg C

10	4.5 NORTHERN PIKE 1
10	4 NORTHERN PIKE 1
10	3 NORTHERN PIKE 1
10	2.5 LAKE WHITEFISH 1

SITE: AKBL
DATE 524
DURATION 2.8
TIME OF SET 1700
TEMPERATURE 13 deg C

11	1.5 CISCO 2

SITE: AKBL
DATE 513
DURATION 3
TIME OF SET 1600
TEMPERATURE 8.8 deg C

12	2 CISCO 1
12	1.5 CISCO 3

SITE: AKBLU
DATE 524
DURATION 2
TIME OF SET 1345
TEMPERATURE 12.8 deg C

13	2.5 COMMON WHITE SUCKER 1
13	2 NORTHERN PIKE 1

SITE: AKBLU
DATE 512
DURATION 3
TIME OF SET 1755
TEMPERATURE 10.5 deg C

14	2.5 CISCO 1
14	2 CISCO 10
14	1.5 CISCO 1

SITE: AKMN
DATE 525
DURATION 2
TIME OF SET 2000
TEMPERATURE 9.5 deg C

15	4.5 COMMON WHITE SUCKER 1
15	4 COMMON WHITE SUCKER 1
15	3.5 COMMON WHITE SUCKER 1
15	3 YELLOW PICKEREL 2
15	2.5 YELLOW PICKEREL 1
15	2.5 NORTHERN PIKE 1

SITE: AKAB
DATE 514
DURATION 2
TIME OF SET 1915
TEMPERATURE 13.1 deg C

16	4.5 CISCO 3
16	4 CISCO 1
16	3.5 CISCO 2
16	3 CISCO 2
16	2.5 CISCO 1

SITE: AKAB
DATE 509
DURATION 2.5
TIME OF SET 1900
TEMPERATURE 13 deg C

17	5 CISCO 1
17	4.5 COMMON WHITE SUCKER 1
17	4.5 CISCO 3
17	4 CISCO 2
17	3.5 CISCO 3

APPENDIX 7 (cont'd)

SITE: AKIC
DATE 514
DURATION 2.5
TIME OF SET 1710
TEMPERATURE 9 deg C

18	5	CISCO 2
18	4.5	CISCO 1
18	3.5	CISCO 1
18	2.5	CISCO 1

SITE: AKIC
DATE 507
DURATION 2
TIME OF SET 1800
TEMPERATURE 4.5 deg C

19	5	CISCO 1
19	3.5	COMMON WHITE SUCKER 1
19	3.5	CISCO 1
19	3	NORTHERN PIKE 2
19	2.5	NORTHERN PIKE 1
19	2.5	CISCO 1
19	2	YELLOW PICKEREL 1
19	1.5	YELLOW PICKEREL 1

SITE: AKMN
DATE 506
DURATION 2.5
TIME OF SET 1930
TEMPERATURE 4.5 deg C

20	5	COMMON WHITE SUCKER 1
20	4.5	COMMON WHITE SUCKER 2
20	4	NORTHERN PIKE 1
20	3.5	YELLOW PICKEREL 1
20	3.5	CISCO 1
20	3	YELLOW PICKEREL 1
20	3	COMMON WHITE SUCKER 1
20	2.5	YELLOW PICKEREL 1
20	2.5	COMMON WHITE SUCKER 2
20	2	NORTHERN PIKE 1
20	2	CISCO 4

SITE: AKML
DATE 610
DURATION 3.5
TIME OF SET 2030
TEMPERATURE 17 deg C

21	1	1

SITE: AKAB
DATE 610
DURATION 2
TIME OF SET 2100
TEMPERATURE 14.2 deg C

22	3.5	YELLOW PICKEREL 1
22	3.5	COMMON WHITE SUCKER 1
22	3.5	CISCO 1

SITE: AKMN
DATE 609
DURATION 1.5
TIME OF SET 1800
TEMPERATURE 15.6 deg C

23	4	LAKE WHITEFISH 1
23	3.5	CISCO 2
23	3.5	LAKE WHITEFISH 1
23	3	CISCO 1

SITE: AKMC
DATE 609
DURATION 2
TIME OF SET 1750
TEMPERATURE 15 deg C

24	4	CISCO 1
24	4	LAKE WHITEFISH 2
24	3.5	NORTHERN PIKE 4
24	3.5	CISCO 2
24	3	COMMON WHITE SUCKER 1
24	3	LAKE WHITEFISH 1
24	2.5	YELLOW PICKEREL 1

SITE: AKSL
DATE 611
DURATION 2.5
TIME OF SET 2020
TEMPERATURE 16.8 deg C

25	4	NORTHERN PIKE 1
25	3.5	COMMON WHITE SUCKER 1
25	3.5	CISCO 1
25	2	CISCO 2
25	1.5	CISCO 4

SITE: AKLS
DATE 609
DURATION 2.5
TIME OF SET 2030
TEMPERATURE 15.5 deg C

26	5	LAKE WHITEFISH 1
26	4	LAKE WHITEFISH 2
26	3.5	CISCO 2
26	3.5	LAKE WHITEFISH 2
26	3	YELLOW PICKEREL 2
26	3	NORTHERN PIKE 1
26	3	LAKE WHITEFISH 2
26	3	YELLOW PERCH 2
26	2.5	YELLOW PICKEREL 1
26	2.5	NORTHERN PIKE 1
26	2.5	CISCO 1
26	2.5	LAKE WHITEFISH 1

SITE: AKMS
DATE 609
DURATION 2
TIME OF SET 2000
TEMPERATURE 13.5 deg C

27	5	LAKE WHITEFISH 2
27	4.5	LAKE WHITEFISH 2
27	4	CISCO 1
27	4	LAKE WHITEFISH 3
27	3.5	CISCO 1
27	3.5	LAKE WHITEFISH 4
27	3	YELLOW PICKEREL 1
27	3	LAKE WHITEFISH 2
27	2.5	CISCO 1
27	2.5	LAKE WHITEFISH 1
27	2	CISCO 2
27	2	LAKE WHITEFISH 1
27	1.5	LAKE WHITEFISH 1

SITE: AKAB
DATE 609
DURATION 3
TIME OF SET 2050
TEMPERATURE 19.6 deg C

28	5	LAKE WHITEFISH 1
28	4.5	LAKE WHITEFISH 1
28	4	COMMON WHITE SUCKER 1
28	4	LAKE WHITEFISH 1
28	3.5	YELLOW PICKEREL 1
28	3.5	CISCO 1
28	3	CISCO 1
28	3	LAKE WHITEFISH 1
28	2.5	YELLOW PICKEREL 1
28	2	NORTHERN PIKE 1

SITE: AKIC
DATE 607
DURATION 2.5
TIME OF SET 1830
TEMPERATURE 19.8 deg C

29	5	YELLOW PICKEREL 1
29	5	COMMON WHITE SUCKER 1
29	4	COMMON WHITE SUCKER 2
29	4	CISCO 4
29	3.5	YELLOW PICKEREL 1
29	3.5	COMMON WHITE SUCKER 1
29	3.5	CISCO 1
29	3	YELLOW PICKEREL 1
29	3	CISCO 2
29	3	YELLOW PERCH 1
29	2.5	CISCO 1
29	1.5	CISCO 2

SITE: AKSLU
DATE 607
DURATION 3
TIME OF SET 1800
TEMPERATURE 14.1 deg C

30	5	COMMON WHITE SUCKER 2
30	2.5	NORTHERN PIKE 1
30	2.5	CISCO 1
30	2	CISCO 6
30	1.5	CISCO 1

APPENDIX 7 (cont'd)

SITE: AKBL
DATE 620
DURATION 2.5
TIME OF SET 2000
TEMPERATURE 20 deg C

31	2.5 CISCO 2
31	2 CISCO 1

SITE: AKML
DATE 620
DURATION 3.25
TIME OF SET 1445
TEMPERATURE 18 deg C

32	2.5 LAKE WHITEFISH 1
32	2 NORTHERN PIKE 1

SITE: AKIC
DATE 619
DURATION 1.5
TIME OF SET 2000
TEMPERATURE 20 deg C

33	4.5 LAKE WHITEFISH 1
33	3.5 COMMON WHITE SUCKER 1
33	3.5 LAKE WHITEFISH 1

SITE: AKBLU
DATE 619
DURATION 2
TIME OF SET 1930
TEMPERATURE 18.9 deg C

34	4.5 BURBOT 1
34	2.5 CISCO 1
34	2 CISCO 3

SITE: AKAB
DATE 619
DURATION 2.5
TIME OF SET 1830
TEMPERATURE 18.8 deg C

35	5 CISCO 1
35	4.5 LAKE WHITEFISH 3
35	2 NORTHERN PIKE 3

SITE: AKMB
DATE 619
DURATION 2.5
TIME OF SET 1800
TEMPERATURE 19 deg C

36	5 LAKE WHITEFISH 3
36	4.5 LAKE WHITEFISH 2
36	3.5 LAKE WHITEFISH 1
36	3 NORTHERN PIKE 1

SITE: AKAD
DATE 618
DURATION 3
TIME OF SET 2100
TEMPERATURE 18 deg C

37	3.5 YELLOW PICKEREL 2
37	3.5 COMMON WHITE SUCKER 1
37	3 YELLOW PICKEREL 1
37	2.5 YELLOW PICKEREL 1
37	2.5 NORTHERN PIKE 1

SITE: AKMC
DATE 618
DURATION 2
TIME OF SET 1840
TEMPERATURE 17.2 deg C

38	5 LAKE WHITEFISH 1
38	4.5 NORTHERN PIKE 1
38	4.5 COMMON WHITE SUCKER 3
38	3.5 YELLOW PICKEREL 4
38	3.5 LAKE WHITEFISH 1
38	1.5 NORTHERN PIKE 1

SITE: AKMN
DATE 618
DURATION 2.5
TIME OF SET 1900
TEMPERATURE 18.2 deg C

39	4.5 LAKE WHITEFISH 1
39	2 LAKE WHITEFISH 1

SITE: AKLS
DATE 618
DURATION 2
TIME OF SET 1650
TEMPERATURE 18.5 deg C

40	4.5 LAKE WHITEFISH 1
40	3.5 LAKE WHITEFISH 2
40	2.5 LAKE WHITEFISH 1

SITE: AKSL
DATE 708
DURATION 2
TIME OF SET 2000
TEMPERATURE 22.4 deg C

41	1 1

SITE: AKSLU
DATE 708
DURATION 1.5
TIME OF SET 1730
TEMPERATURE 22.8 deg C

42	1.5 CISCO 4

SITE: AKML
DATE 707
DURATION 3.5
TIME OF SET 1805
TEMPERATURE 21.4 deg C

43	1 1

SITE: AKAB
DATE 707
DURATION 3
TIME OF SET 1930
TEMPERATURE 22.2 deg C

44	4 COMMON WHITE SUCKER 2
44	4 LAKE WHITEFISH 1
44	3.5 YELLOW PICKEREL 1

SITE: AKIC
DATE 707
DURATION 2.5
TIME OF SET 1930
TEMPERATURE 21.4 deg C

45	5 COMMON WHITE SUCKER 1
45	3.5 COMMON WHITE SUCKER 2
45	3 NORTHERN PIKE 1
45	3 COMMON WHITE SUCKER 1

SITE: AKAD
DATE 706
DURATION 1.5
TIME OF SET 2000
TEMPERATURE 19.5 deg C

46	5 COMMON WHITE SUCKER 1
46	5 LAKE WHITEFISH 1
46	4 COMMON WHITE SUCKER 3
46	3 YELLOW PICKEREL 2
46	3 COMMON WHITE SUCKER 3
46	2.5 COMMON WHITE SUCKER 5
46	2 YELLOW PICKEREL 5
46	1.5 YELLOW PERCH 1

SITE: AKMN
DATE 706
DURATION 4.5
TIME OF SET 1700
TEMPERATURE 19.8 deg C

47	3 CISCO 1

SITE: AKMC
DATE 706
DURATION 3.5
TIME OF SET 1600
TEMPERATURE 19.3 deg C

48	4.5 COMMON WHITE SUCKER 1
48	4 COMMON WHITE SUCKER 1
48	3.5 YELLOW PICKEREL 1
48	3.5 COMMON WHITE SUCKER 3
48	3.5 LAKE WHITEFISH 1
48	3 COMMON WHITE SUCKER 2

APPENDIX 7 (cont'd)

SITE: AKMB
DATE 706
DURATION 2.5
TIME OF SET 1750
TEMPERATURE 20 deg C

49	4.5 LAKE WHITEFISH 3
49	4 LAKE WHITEFISH 1
49	3 CISCO 1
49	3 LAKE WHITEFISH 1
49	1.5 YELLOW PERCH 1

SITE: AKLS
DATE 707
DURATION 1.5
TIME OF SET 1600
TEMPERATURE 19.5 deg C

50	4 LAKE WHITEFISH 1
50	3.5 LAKE WHITEFISH 1
50	2 NORTHERN PIKE 1
50	2 CISCO 1

SITE: AKSL
DATE 807
DURATION 2
TIME OF SET 1900
TEMPERATURE 24 deg C

51	2.5 COMMON WHITE SUCKER 1
51	2 COMMON WHITE SUCKER 1
51	1.5 CISCO 3

SITE: AKAD
DATE 803
DURATION 4.5
TIME OF SET 1940
TEMPERATURE 23.4 deg C

52	4.5 COMMON WHITE SUCKER 1
52	2.5 COMMON WHITE SUCKER 1

SITE: AKLS
DATE 805
DURATION 1.5
TIME OF SET 1700
TEMPERATURE 24.5 deg C

53	4.5 LAKE WHITEFISH 2
53	2.5 CISCO 2

SITE: AKML
DATE 805
DURATION 4
TIME OF SET 1900
TEMPERATURE 24.9 deg C

54	1 1

SITE: AKMC
DATE 804
DURATION 5
TIME OF SET 1600
TEMPERATURE 25.4 deg C

55	4.5 COMMON WHITE SUCKER 1
55	2.5 NORTHERN PIKE 2
55	2 NORTHERN PIKE 1
55	1.5 NORTHERN PIKE 1

SITE: AKSL
DATE 804
DURATION 4.5
TIME OF SET 1500
TEMPERATURE 25.6 deg C

56	1 1

SITE: AKMB
DATE 803
DURATION 2
TIME OF SET 2000
TEMPERATURE 24 deg C

57	4 COMMON WHITE SUCKER 1
57	3.5 CISCO 2
57	3.5 LAKE WHITEFISH 1
57	3 NORTHERN PIKE 1
57	3 CISCO 2
57	3 LAKE WHITEFISH 2
57	2.5 CISCO 4
57	2.5 LAKE WHITEFISH 1
57	2 CISCO 3

SITE: AKAB
DATE 803
DURATION 1.5
TIME OF SET 1945
TEMPERATURE 24.4 deg C

58	3.5 YELLOW PICKEREL 1
58	3 YELLOW PICKEREL 2
58	2 NORTHERN PIKE 1

SITE: AKMC
DATE 803
DURATION 2
TIME OF SET 1720
TEMPERATURE 24 deg C

59	4 CISCO 2
59	3.5 CISCO 1

SITE: AKMN
DATE 803
DURATION 2.5
TIME OF SET 1705
TEMPERATURE 23.9 deg C

60	4.5 CISCO 1
60	3 CISCO 2
60	2 CISCO 1

SITE: AKLS
DATE 901
DURATION 1.5
TIME OF SET 1600
TEMPERATURE 23 deg C

61	3 LAKE WHITEFISH 1

SITE: AKML
DATE 901
DURATION 2.5
TIME OF SET 2130
TEMPERATURE 23.1 deg C

62	2 CISCO 1

SITE: AKAD
DATE 901
DURATION 4
TIME OF SET 2100
TEMPERATURE 23.3 deg C

63	2.5 NORTHERN PIKE 1
63	2 CISCO 1
63	1.5 YELLOW PICKEREL 1

SITE: AKAB
DATE 902
DURATION 3.5
TIME OF SET 1600
TEMPERATURE 24.6 deg C

64	4 COMMON WHITE SUCKER 2
64	3.5 YELLOW PICKEREL 1
64	3 COMMON WHITE SUCKER 1

SITE: AKSLU
DATE 902
DURATION 4
TIME OF SET 1630
TEMPERATURE 24 deg C

65	1 1

SITE: AKIC
DATE 902
DURATION 3
TIME OF SET 1710
TEMPERATURE 24.3 deg C

66	3.5 CISCO 1
66	3 COMMON WHITE SUCKER 1

SITE: AKMN
DATE 901
DURATION 3.5
TIME OF SET 1530
TEMPERATURE 23.5 deg C

67	4.5 COMMON WHITE SUCKER 2
67	3 NORTHERN PIKE 1
67	2 LAKE WHITEFISH 1

APPENDIX 7 (cont'd)

SITE: AKSL
DATE 902
DURATION 2.5
TIME OF SET 1900
TEMPERATURE 24.5 deg C

68	2	COMMON WHITE SUCKER
68	1.5	YELLOW PERCH

SITE: AKMC
DATE 901
DURATION 3.5
TIME OF SET 1510
TEMPERATURE 23.5 deg C

69	4.5	COMMON WHITE SUCKER
69	4.5	COMMON WHITE SUCKER
69	3.5	NORTHERN PIKE
69	1.5	YELLOW PERCH

SITE: AKMN
DATE 901
DURATION 2.75
TIME OF SET 1600
TEMPERATURE 23.2 deg C

70	1	1

SITE: AKML
DATE 924
DURATION 3
TIME OF SET 1700
TEMPERATURE 13.1 deg C

71	2.5	LAKE WHITEFISH 1

SITE: AKSLU
DATE 921
DURATION 2.5
TIME OF SET 1900
TEMPERATURE 13.7 deg C

72	2	CISCO 1
72	1.5	CISCO 4

SITE: AKSL
DATE 924
DURATION 2
TIME OF SET 1840
TEMPERATURE 13 deg C

73	3	COMMON WHITE SUCKER 3
73	2.5	COMMON WHITE SUCKER 1
73	2	CISCO 1
73	1.5	CISCO 7

SITE: AKAD
DATE 924
DURATION 2.5
TIME OF SET 1900
TEMPERATURE 13.3 deg C

74	5	COMMON WHITE SUCKER 1
74	4.5	YELLOW PICKEREL 1
74	4.5	COMMON WHITE SUCKER 2
74	4	YELLOW PICKEREL 1
74	4	COMMON WHITE SUCKER 2
74	3.5	YELLOW PICKEREL 1
74	3.5	CISCO 1
74	2.5	COMMON WHITE SUCKER 1
74	1.5	YELLOW PICKEREL 1
74	1.5	NORTHERN PIKE 1
74	1.5	CISCO 1

SITE: AKMN
DATE 924
DURATION 3
TIME OF SET 1650
TEMPERATURE 14.4 deg C

75	1	1

SITE: AKIC
DATE 921
DURATION 2.5
TIME OF SET 1610
TEMPERATURE 13.6 deg C

76	5	COMMON WHITE SUCKER 1
76	4.5	COMMON WHITE SUCKER 1
76	3	YELLOW PICKEREL 1
76	3	COMMON WHITE SUCKER 1
76	2.5	YELLOW PICKEREL 1
76	2.5	COMMON WHITE SUCKER 1
76	2	NORTHERN PIKE 1

SITE: AKAB
DATE 921
DURATION 2
TIME OF SET 1630
TEMPERATURE 13.5 deg C

77	5	LAKE WHITEFISH 1
77	4	YELLOW PICKEREL 1
77	4	CISCO 1
77	3.5	COMMON WHITE SUCKER 1

SITE: AKMB
DATE 921
DURATION 3.5
TIME OF SET 1540
TEMPERATURE 14.6 deg C

78	4.5	YELLOW PICKEREL 1
78	4.5	COMMON WHITE SUCKER 1
78	3.5	NORTHERN PIKE 1
78	3.5	COMMON WHITE SUCKER 1

SITE: AKMC
DATE 921
DURATION 3
TIME OF SET 1530
TEMPERATURE 13.6 deg C

79	5	COMMON WHITE SUCKER 1
79	3.5	YELLOW PICKEREL 1
79	2	LAKE WHITEFISH 1

SITE: AKLB
DATE 921
DURATION 1.5
TIME OF SET 1815
TEMPERATURE 13.5 deg C

80	4	LAKE WHITEFISH 1

SITE: AKLB
DATE 1002
DURATION 1.75
TIME OF SET 1300
TEMPERATURE 13.5 deg C

81	3.5	NORTHERN PIKE 2
81	3.5	COMMON WHITE SUCKER 2
81	3.5	LAKE WHITEFISH 1
81	3	NORTHERN PIKE 1
81	3	COMMON WHITE SUCKER 3
81	3	LAKE WHITEFISH 1
81	2.5	YELLOW PICKEREL 1
81	2.5	CISCO 1

SITE: AKAD
DATE 1001
DURATION 3.5
TIME OF SET 1650
TEMPERATURE 13.3 deg C

82	4.5	YELLOW PICKEREL 1
82	4.5	NORTHERN PIKE 1
82	4	YELLOW PICKEREL 1
82	4	NORTHERN PIKE 1
82	3.5	YELLOW PICKEREL 2
82	3.5	COMMON WHITE SUCKER 1
82	3.5	CISCO 1
82	3	YELLOW PICKEREL 1
82	3	CISCO 1
82	2.5	YELLOW PICKEREL 3
82	2.5	NORTHERN PIKE 1
82	2.5	CISCO 1
82	1.5	YELLOW PICKEREL 1

SITE: AKML
DATE 1001
DURATION 3
TIME OF SET 1700
TEMPERATURE 13 deg C

83	1	1

SITE: AKMN
DATE 1001
DURATION 2
TIME OF SET 1600
TEMPERATURE 13.1 deg C

84	3	NORTHERN PIKE 1

APPENDIX 7 (cont'd)

SITE: AKMC
DATE 1001
DURATION 2.5
TIME OF SET 1700
TEMPERATURE 13.2 deg C

85	4.5 COMMON WHITE SUCKER 2
85	3 COMMON WHITE SUCKER 1

SITE: AK[illegible]
DATE 1001
DURATION 4
TIME OF SET 1800
TEMPERATURE 13.1 deg C

86	3.5 COMMON WHITE SUCKER 2
86	2 COMMON WHITE SUCKER 1
86	1.5 YELLOW PERCH 4

SITE: AKIC
DATE 1002
DURATION 2
TIME OF SET 1620
TEMPERATURE 13.2 deg C

87	4 YELLOW PICKEREL 1
87	4 NORTHERN PIKE 1
87	3.5 CISCO 1
87	3 NORTHERN PIKE 1
87	3 COMMON WHITE SUCKER 1
87	2.5 CISCO 2
87	2 NORTHERN PIKE 1

SITE: AKSLU
DATE 1002
DURATION 3
TIME OF SET 1630
TEMPERATURE 12.7 deg C

88	1 1

SITE: AKAB
DATE 1002
DURATION 2
TIME OF SET 1600
TEMPERATURE 12.4 deg C

89	4 COMMON WHITE SUCKER 1
89	4 CISCO 1
89	3.5 CISCO 2
89	3 CISCO 1
89	1.5 COMMON WHITE SUCKER 1

SITE: [illegible]
DATE 1002
DURATION 2.5
TIME OF SET 1900
TEMPERATURE 12.7 deg C

90	2 COMMON WHITE SUCKER 1

SITE: AKSL
DATE 1028
DURATION 2.75
TIME OF SET 1115
TEMPERATURE 7 deg C

91	5 COMMON WHITE SUCKER 1
91	2.5 NORTHERN PIKE 1
91	2 CISCO 1
91	1.5 YELLOW PERCH 1

SITE: AKSLU
DATE 1026
DURATION 2.25
TIME OF SET 1315
TEMPERATURE 7 deg C

92	1 1

SITE: AKMN
DATE 1026
DURATION 3.2
TIME OF SET 840
TEMPERATURE 7 deg C

93	3 YELLOW PICKEREL 3
93	3 NORTHERN PIKE 1
93	3 CISCO 3
93	2.5 NORTHERN PIKE 1
93	2 YELLOW PICKEREL 1

SITE: AKAD
DATE 1026
DURATION 2.7
TIME OF SET 805
TEMPERATURE 7 deg C

94	5 YELLOW PICKEREL 1
94	4.5 NORTHERN PIKE 1
94	4.5 CISCO 1
94	4.5 LAKE WHITEFISH 1
94	4 NORTHERN PIKE 1
94	4 CISCO 4
94	3.5 NORTHERN PIKE 1
94	3.5 CISCO 2
94	3.5 LAKE WHITEFISH 1
94	3 NORTHERN PIKE 1
94	3 CISCO 3
94	2 NORTHERN PIKE 1
94	2 CISCO 2
94	2 LAKE WHITEFISH 2

SITE: AKML
DATE 1026
DURATION 2.75
TIME OF SET 815
TEMPERATURE 7.5 deg C

95	1 1

SITE: AKIC
DATE 1025
DURATION 2.25
TIME OF SET 1415
TEMPERATURE 7 deg C

96	5 NORTHERN PIKE 1
96	5 COMMON WHITE SUCKER 1
96	4.5 COMMON WHITE SUCKER 3
96	4 YELLOW PICKEREL 1
96	3 YELLOW PICKEREL 1
96	3 COMMON WHITE SUCKER 1
96	1.5 YELLOW PERCH 1

SITE: AKLS
DATE 1025
DURATION 2
TIME OF SET 955
TEMPERATURE 7.5 deg C

97	4.5 NORTHERN PIKE 1
97	4 YELLOW PICKEREL 3
97	4 CISCO 1
97	4 LAKE WHITEFISH 1
97	3.5 YELLOW PICKEREL 4
97	3 YELLOW PICKEREL 1
97	3 COMMON WHITE SUCKER 1
97	3 LAKE WHITEFISH 1

SITE: AKMC
DATE 1025
DURATION 2.1
TIME OF SET 940
TEMPERATURE 8 deg C

98	4 COMMON WHITE SUCKER 1
98	3.5 CISCO 2
98	3 CISCO 3
98	3 LAKE WHITEFISH 1
98	2.5 YELLOW PICKEREL 1
98	2.5 CISCO 1

SITE: AKMS
DATE 1025
DURATION 3
TIME OF SET 930
TEMPERATURE 8 deg C

99	3 YELLOW PICKEREL 1
99	2 YELLOW PICKEREL 1
99	2 NORTHERN PIKE 1
99	2 CISCO 1

SITE: AKAB
DATE 1025
DURATION 3.5
TIME OF SET 920
TEMPERATURE 7 deg C

100	4 COMMON WHITE SUCKER 1
100	2.5 NORTHERN PIKE 1
100	1.5 NORTHERN PIKE 1

SITE: AKLS
DATE 1101
DURATION 1.95
TIME OF SET 1250
TEMPERATURE 8 deg C

101	3 LAKE WHITEFISH 1
101	2.5 NORTHERN PIKE 1
101	2.5 LAKE WHITEFISH 1

SITE: AKMS
DATE 1101
DURATION 2.45
TIME OF SET 1305
TEMPERATURE 7 deg C

102	4 YELLOW PICKEREL 1
102	4 NORTHERN PIKE 1
102	3.5 YELLOW PICKEREL 3
102	3.5 COMMON WHITE SUCKER 1
102	3 CISCO 1
102	2.5 CISCO 1
102	1.5 COMMON WHITE SUCKER 1

APPENDIX 7 (cont'd)

SITE: AKAB
DATE 1101
DURATION 2.75
TIME OF SET 1314
TEMPERATURE 7 deg C

103	3.5	CISCO 3
103	3.5	COMMON WHITE SUCKER 1
103	3	CISCO 1
103	2	NORTHERN PIKE 3

SITE: AKMC
DATE 1102
DURATION 3.25
TIME OF SET 1215
TEMPERATURE 7 deg C

109	4.5	LAKE WHITEFISH 1
109	4	YELLOW PICKEREL 2
109	4	COMMON WHITE SUCKER 2
109	3	LAKE WHITEFISH 2

SITE: AKBLU
DATE 1101
DURATION 3
TIME OF SET 1330
TEMPERATURE 8 deg C

104	5	COMMON WHITE SUCKER 2
104	3	NORTHERN PIKE 1

SITE: AKBL
DATE 1102
DURATION 2.3
TIME OF SET 1500
TEMPERATURE 7 deg C

110	2.5	COMMON WHITE SUCKER 1
110	2	CISCO 3

SITE: AKIC
DATE 1101
DURATION 3
TIME OF SET 1530
TEMPERATURE 7 deg C

105	5	COMMON WHITE SUCKER 5
105	4.5	COMMON WHITE SUCKER 5
105	4.5	YELLOW PICKEREL 1
105	4	COMMON WHITE SUCKER 3
105	4	YELLOW PICKEREL 1
105	4	CISCO 2
105	3.5	YELLOW PICKEREL 1
105	3	COMMON WHITE SUCKER 2
105	3	NORTHERN PIKE 1
105	2.5	CISCO 1
105	2	YELLOW PICKEREL 1
105	1.5	CISCO 1
105	1.5	YELLOW PICKEREL 1

SITE: AKMN
DATE 1102
DURATION 2.75
TIME OF SET 1230
TEMPERATURE 8 deg C

106	1	1

SITE: AKML
DATE 1102
DURATION 2
TIME OF SET 1150
TEMPERATURE 7 deg C

107	3.5	NORTHERN PIKE 1

SITE: AKAD
DATE 1102
DURATION 2.25
TIME OF SET 1245
TEMPERATURE 8 deg C

108	4	COMMON WHITE SUCKER 1
108	3	CISCO 1
108	2.5	NORTHERN PIKE 1
108	2.5	CISCO 1